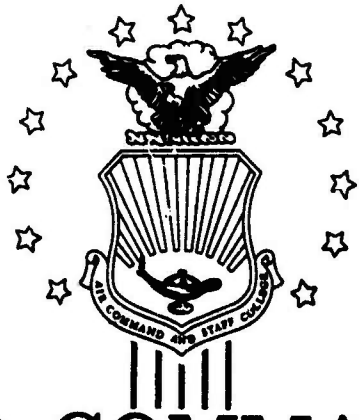

AIR COMMAND AND STAFF COLLEGE

STUDENT REPORT

AIR-TO-AIR CONTINUATION TRAINING IN THE TACTICAL AIR COMMAND

MAJOR BRANFORD J. McALLISTER 85-1780

"insights into tomorrow"

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The air-to-air training system in use today is the product of an 80-year evolution. In the past, peacetime air combat training was neglected due to budget constraints and a lack of emphasis in airpower doctrine. Since 1973, TAC has instituted unprecedented air-to-air training programs (Red Flag, Aggressors, DACT). Yet recent trends (accidents, weak areas during Aggressor visits) indicate shortcomings in day-to-day continuation training programs. This study has three parts: (1) a summary of the evolution of air-to-air training in the US; (2) an analysis of current problems external to squadrons that hinder the planning and execution of air-to-air continuation training programs, and some recommendations; and (3) a set of planning guidelines useful to squadrons in planning their program, based on current constraints.

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PREFACE

The official doctrine of the US Air Force emphasizes air superiority as the first priority of air forces. Until the post-Vietnam era, however, peacetime tactical training prepared fighter aircrews inadequately for air-to-air combat--partly because of budget constraints and partly as a reflection of air force doctrine. Today, training reflects the importance of preparing properly for air-to-air combat. Yet there is evidence that, in spite of remarkable improvements in air combat training, some weaknesses still exist.

This paper examines air-to-air continuation training in the USAF: past, present, and future. The chapters are written to stand alone. Chapter Two is written for the reader interested in the history of air-to-air training in the US. Chapters Three and Four address the state of training in the Tactical Air Command today: the former identifying current problems <u>above</u> the squadron level, the latter offering some help for squadrons in planning their training.

The author is well aware that what squadrons need <u>least</u> today is another training system to monitor. Therefore, Chapter Three is provided to acknowledge, identify, and possibly correct some of the problems with the current system which limit the ability of squadrons to plan and successfully execute air-to-air continuation training programs. Chapter Four, then, assimilates a number of training concepts to provide squadrons a shopping list from which to pick and choose for their unique training needs. It is not meant to be a universal training scheme to cure all ills in continuation training. The reader is encouraged to use Chapter Four critically and selectively.

Chapter Four contains the major emphasis of this project. The author believes i would be used best in the Fighter Weapons School during the Weapons Officer academic course. Another effective use may be as the basis of a pamphlet for use in operational squadrons by operations officers, weapons officers, training officers, and schedulers. Subject to clearance, the author also intends to publish portions of Chapters Three and Four in the <u>USAF Fighter Weapons Review</u>.

The author has attempted to avoid an over-use of air force jargon, especially in Chapter Two. However, some acronyms have become the accepted name for a concept (such as "radar"). This is quite common in fighter aviation where aircrews seldom, if ever, refer to such terms as BFM and ACM by their real meanings (Basic Fighter Maneuvers and Air Combat Maneuvers)--thus, the frequent use of these terms in this paper. A glossary is, therefore, provided after Chapter Five.

CONTINUED

This material is being submitted to the faculty of the University of Alabama in partial fulfillment of the requirements for the Master of Arts degree in Military History.

The opinions expressed in this paper represent those of the author and do not necessarily reflect the official views of the US Air Force, the Tactical Air Command, or the Air University.

ABOUT THE AUTHOR

Maj Branford McAllister graduated from the USAF Academy in 1975 and completed pilot training at Williams AFB, Arizona, in 1976. Following Fighter Lead-in Training at Holloman AFB, New Mexico, he completed F-15 upgrade training at Luke AFB, Arizona, in June 1977. He then received orders to Bitburg AB, Germany, which was converting from F-4s to F-15s. Enroute to Europe, Maj McAllister participated in the Ready Eagle mission ready upgrade program at Langley AFB, Virginia, and arrived at Bitburg in August 1977. As a member of the 22d Tactical Fighter Squadron (TFS), Maj McAllister performed duties as Squadron Historian, Weapons Officer, and Instructor Pilot. In May 1979, Maj McAllister became an instructor pilot in the 36th Tactical Fighter Wing Consolidated Training Unit, upgrading new pilots to mission ready status. In November 1979, he was assigned as a Stan Eval Flight Examiner, a job he held until September 1980. In October 1980, Maj McAllister was assigned to Headquarters USAF, Deputy Chief of Staff for Plans and Operations, for a one-year ASTRA tour. In October 1981, Maj McAllister returned to flying with the 71 TFS at Langley AFB and served as an Instructor Pilot and Chief of Scheduling. In 1982, Maj McAllister attended the F-15 Fighter Weapons School, completing the course as the Outstanding Graduate. Back at Langley, Maj McAllister served as the 71 TFS Chief of Weapons and Tactics and as a Flight Commander until his departure for Air Command and Staff College in August 1984. Maj McAllister has over 1600 hours in the F-15 and has flown in a variety of TAC and USAFE training exercises including Red Flag, Gallant Eagle, Quick Thrust, Quick Force, and Oksboel.

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Part of our College mission is distribution of the students' problem solving products to DoD sponsors and other interested agencies to enhance insight into contemporary, defense related issues. While the College has accepted this product as meeting academic requirements for graduation, the views and opinions expressed or implied are solely those of the author and should not be construed as carrying official sanction.

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REPORT NUMBER 85-1780

AUTHOR(S) MAJOR BRANFORD J. MCALLISTER, USAF

TITLE AIR-TO-AIR CONTINUATION TRAINING IN THE TACTICAL AIR COMMAND

I. Purpose: To provide concepts for improving the overall quality of air-to-air continuation training in TAC.

II. Problem: Despite the improvements in air-to-air continuation training since the Southeast Asia conflict, there are indications that day-to-day squadron training programs have significant shortcomings. The problems are found in two areas: factors above the squadron level which inhibit the planning and execution of training programs (regulations and policies), and ineffective or non-existent squadron planning.

III. Discussion of Analysis: The air-to-air training system in use today is the product of an 80-year evolution. In the past, peacetime air combat training was neglected due to budget constraints and a lack of emphasis in airpower doctrine. Yet in each of four wars this century, air combat occurred despite our lack of preparedness. Since 1973, TAC has instituted unprecedented air-to-air training programs including Red Flag, the Aggressors, and DACT. Yet recent trends indicate some weaknesses in day-to-day training programs (accident trends since 1982, recurring weak areas during Aggressor visits). Several problems account for these trends. TAC Manual 51-50 has become so complex that a significant effort is required to track its requirements. The event-accomplishment orientation in TACM 51-50 places more emphasis on the events than on realistic tactical scenarios. Current evaluation systems (ORIs, MEIs and Stan Eval) are not closely related to the daily training programs resulting in the

encouragement of artificial tactics and procedures necessary to pass the evaluations. Current flying time management policies (monthly utilization rates, deviation reporting) likewise diminish the quality of the training. Add to these constraints the high number of overhead fliers and extensive upgrade training loads (due to low average time on station) and the benefits of recent increases in flying hours are diluted. Finally, not all squadrons consistently plan effective continuation training programs.

IV. Conclusions: Recent trends indicate a problem in day-to-day squadron-level air-to-air continuation training. Squadrons that regularly plan training face difficulties executing their plans because of overly complex and constraining regulations and policies. The primary training manual is overly complex and constraining. The evaluation process is disconnected from the training program. Flying time management does not encourage quality training. Finally, squadrons need some guidelines to aid in planning effective training programs.

V. Recommendations: TAC should reduce the constraints on squadron planning of training programs. In particular, TAC should rewrite TACM 51-50, strengthen the relationship between training and evaluation, and increase squadron flexibility in managing flying time. TAC should publish Chapter Four of this paper as a Fighter Weapons School text and as a pamphlet for use in operational squadrons. Finally, TAC should initiate studies into additional problem areas identified but not analyzed in this paper.

Chapter One

INTRODUCTION

BACKGROUND

The basic manual for Air Force doctrine, AF Manual 1-1, states, air superiority is the "first priority of aerospace forces" (22:2-12). This principle has been confirmed in four wars involving the United States since the first powered flight. Unfortunately, history has also shown that we were unprepared for air combat in each war. For example, Lt Col Mike Press, a former Aggressor squadron commander, stated, "Almost to a man, every fighter pilot who even saw a MiG in Vietnam said his training did not prepare him for the engagement" (13:3). While we have historically enjoyed the luxury of sufficient time to mobilize and train for warfighting, it is unlikely we will be so lucky in the future. As General Charles A. Gabriel, the USAF Chief of Staff points out, the British in the Falklands "were faced with the challenge of conducting a war in an improbable place, and under severe weather conditions, against an unexpected foe. To meet the challenge, they had to fight with the men and equipment they had on hand. We, in the United States Air Force, could easily be faced with similar challenges--it has happened before" (6:2).

How can we meet the challenge of "unexpected" combat? A number of factors affect the outcome of aerial combat: the threat, the environment, our combat experience, the quality of personnel entering the Air Force, our aircraft and weapons, the amount of flying time appropriated by Congress, and the quality of our training. Of these factors, the only one Air Force squadrons can control is their training. The "Project Red Baron" reports following the Vietnam conflict confirmed this idea by stating, "Levels of combat experience and air combat training appear to have the greatest effect on a pilot's ability to succeed in air-to-air combat. However, only training is available for peacetime exercises" (50:23). The consistent air-to-air successes of the Israeli Air Force have been attributed to the superiority of their training, not necessarily to the aircraft they flew (9:78). Steve Ritchie, the first USAF ace in Southeast Asia, commented, "The pilot most likely to succeed is the one most highly trained. Stated another way, a superior pilot in an inferior aircraft will defeat an inferior pilot in a superior aircraft" (57:48).

It is primarily the quality of the training that counts. "The combat capability of today's fighter force is based on the ability to develop tactics for the high threat, train those tactics, and evaluate the results under peacetime constraints" (52:ii). In short, combat capability hinges on realism in training. Only by practicing against a realistic simulated threat in a realistic environment can we develop the skills and tactics appropriate for war. The measuring stick is the wartime mission (14:9). Clearly, the Air Force has made substantial progress in the quality of its training since the end of the war in Southeast Asia: the Aggressors were formed, Red Flag was initiated, Dissimilar

Air Combat Training increased, and evaluation criteria have improved. Nevertheless, there is one area where significant improvement would lead to measurable gains in capability: squadron-level continuation training

THE PROBLEM

The creation of Red Flag and the Aggressors was a big step forward over training conducted before 1973. But, although "modern" fighter training is often characterized by reference to "Flag" exercises and the Aggressors, these actually represent only a small percentage of the overall training accomplished. More precisely, they represent the culmination of day-to-day training programs and serve to measure a unit's capability to fight and win in the best available peacetime simulation of combat.

While the quality of day-to-day missions has improved over the last 10 years, there are indications that day-to-day continuation training in the Tactical Air Command (TAC) today has considerable room for improvement. Since 1982, TAC has experienced seven air-to-air accidents due to loss of control directly attributed to operator error. There were only three in the previous three years. More importantly, the most recent accidents involved experienced aircrews whereas in the past most operator-factor accidents involved non-experienced crews (62:--). Fighter Weapons School instructors have also observed recurring weak areas during Aggressor deployments to F-15 wings. These include Basic Fighter Maneuvers, weapons employment, radar work, four-ship employment, and electronic countermeasures (67:--; 69:--). Squadron weapons officers and flight commanders echo a concern over a lack of four-ship proficiency (63:--). In a 1983 survey given to one F-15 squadron, the respondents consistently expressed concern for proficiency in four-ship tactics, low-altitude employment, and electronic countermeasures (42:--). While there will always be recurring mistakes and lessons learned during tactical training, this consensus of major weak areas demands a re-examination of our training programs.

PURPOSE

This project is based upon the premise that realistic training is the single factor squadrons can control to achieve the necessary capability to fight and win in combat. However, not every squadron tasked for air-to-air successfully executes an organized program of training. There are many reasons why, but the most significant are (1) external factors (training publications and policies) and (2) poor squadron planning and execution. Thus, the first purpose of this project is to identify problems with official publications and procedures which hinder squadron training plans, followed by some suggested improvements; secondly, to provide some guidelines useful to squadrons in planning beneficial continuation training programs based on current constraints.

SCOPE

This project analyzes air-to-air continuation training in TAC operational squadrons. The primary focus is on F-15 squadrons, currently the only TAC operational units flying exclusively air-to-air. However, the project may have significant application for any squadron training for air-to-air combat, even as a secondary mission. The focus is on the training performed by combat ready aircrews training for their wartime mission. This excludes formalized upgrade training such as Replacement Training Unit (RTU) syllabi, Mission Qualification Training (MQT), Flight Lead upgrade training, and Instructor Pilot (IP) upgrade training. Also excluded are Air Defense Tactical Air Command (ADTAC), Air National Guard, and Air Force Reserve squadrons. The information for this project comes from TAC. While there may be some differences in training, the author envisions that the concepts presented have application to the other three tactical major commands: Pacific Air Forces (PACAF), United States Air Forces in Europe (USAFE), and Alaskan Air Command (AAC).

A WORD ABOUT DEFINITIONS

In this paper, "air-to-air" and "air combat" refer to combat between fighters and all types of adversary aircraft occurring during such specialized fighter missions as sweep, combat air patrol (CAP), force protection (escort), and air defense. These missions are defined in the Glossary. The term "air superiority" refers to the situation when friendly aircraft enjoy "the capability to use the enemy's airspace to perform our combat missions and to deny the enemy the use of our airspace" (22:2-12). As there are some non-air-to-air missions that contribute to the quest for air superiority (such as the suppression of enemy air defenses, or SEAD, flown by Wild Weasels), air-to-air is, in fact, a subset of air superiority.

There are a number of training missions designed to gain and maintain proficiency in the various phases of air combat missions including Intercepts, Basic Fighter Maneuvers (BFM), Air Combat Maneuvering (ACM), and Air Combat Tactics (ACT). Historically, ACM and ACT have been used interchangeably. In recent years, the air-to-air community has settled on a distinction now expressed in TAC Regulation 55-79. ACM is "training designed to achieve proficiency in element [2-ship] formation maneuvering and the coordinated application of BFM to achieve a simulated kill or effectively defend against one or more aircraft from a preplanned starting position" (33:10-2). Most often, ACM is flown as two versus one ("2 V 1") and focuses on the visual maneuvering arena. ACT is "the application of BFM, ACM, and intercept skills to achieve a tactical air-to-air objective" (33:10-2). ACT, therefore, encompasses all phases of an air combat mission, not just the visual arena, and is flown as two versus two ("2 V 2") with similar adversaries. BFM, ACM, and ACT may be flown against dissimilar opponents--the mission is then called DBFM (Dissimilar BFM), DACM, or DACT. DACT has also become a generic term encompassing all dissimilar missions, from "1 V 1" up to "X V X".

Similarly, the fighter community expresses a wide variety of definitions of the concepts of "training plan" and "training program." These terms will be used synonymously as any plan for a unit's training, including such items as the mission types scheduled and non-flying training. The extent of this planning varies considerably. Some unit programs are based solely on the requirements of TAC Manual (TACM) 51-50 and others are complex, formalized six-month plans which integrate scenarios and academics.

OVERVIEW

Chapter Two of this paper describes the evolution of air combat training emphasizing two themes: the effect of peacetime budgetary constraints and mindset on the quantity and quality of training; and the degree that training reflected operational doctrine, the roles and missions planners envisioned for air forces.

Chapter Three examines the current status of air-to-air continuation training in TAC. It analyzes why squadrons are not always successful in planning and executing productive training programs by examining factors out of their control: planning documents, the evaluation process, flying time management, personnel turmoil, wing-level support, and other miscellaneous constraints.

Acknowledging the many constraints on squadron training programs, Chapter Four proposes some guidelines and suggestions for planning a balanced training program. Such guidelines include the formulation of objectives, types of missions, and squadron-level evaluation of training.

Chapter Five summarizes the main conclusions and offers some recommendations.

Chapter Two

THE EVOLUTION OF AIR-TO-AIR TRAINING IN THE UNITED STATES

To understand the character of air-to-air training in the 1980s, it is instructive to review the turbulent evolution of fighter aviation since its rudimentary beginnings before World War I. The US has entered each war unprepared for air-to-air combat--poorly equipped and inadequately trained. To account for this, two themes are prevalent. First, air-to-air training has reflected fluctuating airpower doctrine. These official principles and precepts guiding the employment of air forces were often entangled in emotional debates over air force independence and scarce budget allocations. Historically, airpower doctrine reflected the pre-eminence of strategic thinking and the underestimation of the necessity for tactical air superiority. Secondly, the rapid peacetime demobilization and budget cutbacks following every war diminished the quantity of tactical training (flying hours allotted) and the quality of our weapons systems. Together, these two themes resulted in a traditional lack of preparation for air-to-air combat, overcome with time as the US military machine geared up to meet the challenge.

WORLD WAR I

While the US produced the first powered flight by the Wright brothers in 1903, the development of military uses of the aircraft in this country was beset with skepticism and a lack of funds. On the other hand, civilian aviation progressed and the enthusiasm for aviation in Europe never waned (2:59). In 1911, the first US flying school was finally established at College Park, Maryland. From 1911 to 1914, some strides were made in testing new machine guns, bomb-dropping devices, and experiments with roles for the aircraft such as directing army artillery fire (2:60-61). However, despite the evidence from Europe that the airplane was changing the nature of warfare, the Army's aviation exploits were primitive and unscientific (2:65). The Germans and the French first used the aircraft for artillery spotting and reconnaissance. To counter this threat, the French began to mount machine guns on aircraft. Frenchman Roland Garros was credited with mounting the first forward-firing machine gun on an aircraft and what followed was the birth of air combat tactics as we know them today (60:6-8). "Dogfighting," as it came to be known, evolved with the teamwork concepts invented by German aces Boelcke and Richtofen. They developed the first concepts of coordinated two-ship and four-ship tactics (60:7).

American involvement in the war prior to 1917 was confined to the volunteers who joined foreign aviation units such as the Lafayette Escadrille (2:68). When the US declared war on Germany on 6 April 1917, the Air Service possessed few pilots, few training planes, and had not trained any aviators for combat. No US airplane had a mounted machine gun and no American military pilot had engaged in aerial combat (2:72).

Also, the "whole training process was hampered by a lack of flying knowledge and by the nonexistence of a training philosophy" (3:18-19). Prior to World War I, no one knew what to train pilots for because the role of aviation was largely undecided. The emphasis was on learning to fly. Initially, employment and maneuvers were limited to tactical reconnaissance and observation (3:20). After the war began, training in the US consisted of extensive ground school and flying which emphasized aircraft handling, cross country, navigation, and acrobatics (2:79). Following this basic training, US pilots were sent to Europe to learn to fly combat planes. Often, however, pilots were sent into combat with as few as 17 hours of flying time (3:19), and with no gunnery training (2:81). The allies lost many inexperienced pilots "who scarcely knew how to fly" (3:28). In September 1917, the US started its own advanced pilot training program consisting of navigation, bombing, and gunnery (49:8).

In France, US Air Service tactical aviation was generally employed in accordance with the ground battle plan by providing observation for the infantry (1:13). Air-to-air combat evolved to prevent such reconnaissance. On 14 April 1918, Lieutenants Alan Winslow and Douglas Campbell achieved the first American aerial victories by downing two German aircraft (2:81). However, little, if any, air combat training was accomplished (2:72). Without much knowledge to draw upon, the skills and tactics of aerial combat were self-taught through trial and error in the use of armament (machine guns) and maneuvering into firing position (aerial combat tactics) (59:5). Despite a lack of formal training, though, Americans claimed 781 planes while losing 289 for a 2.7:1 kill ratio (2:84).

POST-WORLD WAR I

Perhaps because aviation did not strike any decisive military blows in the war (3:27-28), the lessons of air employment were forgotten by all but a few dedicated career airmen. Following the war, the US withdrew into isolation and the US military, especially the Air Service, suffered (2:87). Demobilization brought a severe constriction in men, materials, and money (3:59). US forces were quickly disbanded and only a token air force was maintained. Considerable combat experience was lost (60:8). Nevertheless, military pilots had learned one lesson: aerial combat would be a major factor in any future war (59:5).

During the inter-war period, aviation was in a chaotic state and arguments raged over the proper roles and organization of the Air Service (1:22). Air forces world-wide had to compete against older services and were indeed fighting to justify their existence (3:59). In striving to make the public and the government aware of the importance of air power, fliers "sought to stir the public mind with record-breaking headlines and acrobatic displays" (3:60). Military pilots such as Jimmy Doolittle were involved in racing and long distance flights. Between 1919 and 1929, the Air Service made notable achievements in speed, distance, altitude, midair refueling, and endurance (2:99-106). In 1918, the Air Service participated in the first of two experiments with airmail service (2:89). Nevertheless, despite these "non-military" ventures, aviation made considerable improvements in flying techniques, navigation, and training. More importantly, the public finally began to realize the potential of the airplane (2:106).

In June 1920 Congress established pursuit, bombardment, and observation units in the Air Service (2:99). That same year, the first evidence of a training philosophy

appeared. The War Department issued instructions that all training data would be prepared in a new series of regulations. The belief grew that the first duty of air forces was "to gain and hold control of the air, by seeking out and destroying the hostile air forces, wherever it may be found" (1:23). These ideas were incorporated in preliminary form in the Air Service Training Regulation No. 440-15, "Fundamental Conceptions of the Air Service," dated 1923. In 1926, 440-15 defined, for the first time, the specific missions of air forces: assisting ground forces by destroying enemy aviation, attacking enemy ground forces, aerial observation, and messenger service. The organization and training of all air units was based on the fundamental doctrine of supporting ground forces (1:28).

Training guidance began to appear as the War Department solidified its concept of air power. For example, the Adjutant General of the War Department issued order number AG-353, "Training Program for Air Service Units, 1925," expressing several enduring fundamentals for training. Training programs were intended to provide a "uniform, progressive, and continuous course of training in Air Service subjects" to reach "a high standard of proficiency" and the "ability on the part of the tactical units to operate efficiently and effectively in all phases of the work which they are required to perform." Training was organized into progressive phases beginning with individual proficiency training, unit training, aerial gunnery, and field training exercises with the infantry (combined training) (48:1). Training was specified for three categories: pursuit, bomber, and observation. Pursuit (or fighter) training consisted of ground school and exams in such subjects as radio communication, bombing, aerial gunnery, navigation, night flying, parachutes, and the use of oxygen equipment. Flying training included bombing, aerial gunnery, navigation, formation flying, combat maneuvers, and night flying (48:14).

In 1926, the Air Corps Act changed the name of the Air Service to the Air Corps and began a five-year expansion program. The Air Corps had accepted the doctrine that control of the air was necessary for effective air, ground, and naval operations. The main role of pursuit aviation was to seek out and destroy the hostile air force (1:29-30). Unfortunately, the five year expansion plans were never fully implemented due to a lack of funding. Furthermore, the question of how to achieve "air superiority" was subject to debate.

The 1920s were characterized as the "Billy Mitchell era"--the fight for air force independence and the emergence of the belief in the efficacy of offensive, strategic aerial warfare (2:107). At the Air Corps Tactical School in 1931, the notion developed that air superiority would be achieved through bombardment of enemy air fields, depots, and factories as well as by destroying enemy aircraft in the air. Pursuit aviation alone could not adequately protect vital resources from air attack. The primacy of bombardment aviation was born (1:33).

From the Air Corps Tactical School influence in the 1930s evolved the "invincible bomber theory" and the development of the B-17. Strategic theorists claimed that the most efficient means of neutralizing an enemy air offensive was to conduct "counter air" operations against his bases (1:43). Bombers did not require fighter escort--they were self-protecting (2:135). One concession was the need for friendly defenses--the development of an "interceptor" aircraft along the eventual lines of the P-38, P-39, and P-40.

A few dissenters at the Air Corps Tactical School argued that pursuit aviation was a viable weapon and there was a need for the capability to defeat the enemy in the air (1:43). They urged the development of the fighter as a "flying gun platform" with long-range capabilities for ground attack and for interception. Unfortunately, pursuit doctrine never fully developed and pursuit planes were a compromise among competing concepts of their use (2:135).

Nevertheless, despite inadequate resources and the antipathy for pursuit doctrine, training progressed. In 1933, order number AG-353 specified a total of 215 hours per pilot per year for pursuit groups (46:9-12). Training was clearly focused by the Board of Revision of Training Methods (1934) which stated, "The ultimate purpose of all military training is effectiveness in war. . . . Tactical proficiency is the ultimate goal of military training. . . . All military training should, therefore, be directed toward definite training objectives leading progressively toward effectiveness for combined action in war" (20:4). The importance of realistic evaluation was also well established: "The measure of proficiency of the unit is based on the ability of the unit to carry out effectively and efficiently, on short notice any or all of its assigned missions. . . . Proficiency will be proved by actual test when ever possible" (47:1-2). The early roots of the Operational Readiness Inspection were evident in Aviation Regulation 265-10 which specified the nature of tests to determine the readiness of Air Corps tactical units for active field service (47:3). Units were required to be able to leave their home station within 24 hours, proceed to an advanced airdrome, and operate. Proficiency was required in delivering accurate and effective aerial attacks against any type of aircraft or formation of aircraft, defend friendly forces from ground fire and air attacks, and intercept aircraft by means of aerial patrol (47:4). As depicted in Table 1, flying hour guidelines were specified for advanced training (individual skills), unit training (involving up to squadron-size formations), and combined training (with other army branches).

As war in Europe became a reality in the late 1930s, the successes of the German Luftwaffe confirmed the value of airpower. In 1938, President Roosevelt stated that aircraft, not ground forces, were the implements of war which would have an influence on Hitler's actions. As the Luftwaffe's successes grew, the Air Corps embarked on a huge expansion program, but this did not end the controversy over Air Corps missions (1:49). In 1939, the War Department Air Board reported, "The basis of Air Power is the bombardment plane" (1:51). Pursuit aviation continued to suffer from myopic views of tactical roles and missions and the slow development of new aircraft. In 1940, Field Manual 1-5, "Employment of the Aviation of the Army," continued to support the old relationship between air and ground warfare by specifying such missions as reconnaissance, observation, and liaison. Strategic air operations by bombardment aviation would nullify the enemy's war effort. Pursuit aviation would be used only for defense of important areas, installations, forces, and for protection of other aircraft in flight (1:51).

The results of the air war in Europe in 1940 (specifically the Battle of Britain) prompted Gen Hap Arnold to doubt the prevailing "invincible bomber" theory that fighter aircraft could not shoot down large bombers. He initiated a study of pursuit aviation which concluded that American bombers enjoyed greater firepower than European bombers. However, the study also recommended improvements in pursuit aircraft, training, and the development of a long-range fighter. But, the final conclusion stated

Advanced Training	Hours
Acrobatics	10
Gunnery/Bombing	20
Navigation	45
Individual Combat	10
Formation Flying	10
Instrument Flying	20
Night Flying	20
Performance Flights	4
TOTAL	139
Unit Training	
Combat Exercises	15
Navigation/Cross Country	15
Unit-sized formation	15
Night Flying	10
Performance Flights	2
Techniques, Tactics, and Employment	35
Field Exercises	20
TOTAL	112
Combined Training	
TOTAL	45
OVERALL TRAINING	
GRAND TOTAL	296

Table 1. Pursuit Flying Training 1935 (47:12-19)

that no thought should be given to reducing the importance of bombardment aviation (1:52).

Not surprisingly, the first major strategic air war plan produced by the newly-formed Army Air Force (AAF) staff, AWPD-1, "Munitions Requirements of the Army Air Forces," advocated daylight precision bombing against the German economic support for her war machine. The staff believed that reliance on speed, formations, high altitude, defensive firepower, armor, and simultaneous multiple attacks would make bomber penetrations feasible. Additionally, they suggested the development of an escort fighter with the range and speed of bombers. In establishing the requirement for pursuit aircraft, the air staff declared that the principle role of pursuit was to protect vital bases and areas while air superiority would be won by bombers. Following the attainment of air superiority by strategic forces, there might be the need for tactical air support of ground operations (1:59-60).

A lack of doctrine was not the only problem facing pursuit aviation just prior to World War II. Most pursuit groups had difficulty approaching the level of proficiency desired because of the rapid personnel expansion in the late 1930s, a shortage of aircraft, low experience levels, inexperienced maintenance personnel, and the rapid changes in aerial tactics (24:5). In September 1938, the 20th Pursuit Group reported 53 pilots and 1 combat plane. Moreover, training suffered from preoccupation with administrative duties incident to reorganization and growth, a lack of training ranges, and a lack of tow targets for aerial gunnery. A substantial number of pilots were detached to ferry US aircraft to our allies already in combat and to participate in service tests of new equipment. Most of the flying performed in operational units was used to train new personnel (23:6). In the fall of 1941, the AAF held maneuvers in the Carolinas to test the proficiency of certain pursuit groups. Brig Gen Clarence L. Tinker of the III Interceptor Command noted the "very sad deficiency" of pursuit units in the essentials of combat. He urged a re-emphasis in gunnery, night flying, instrument flying, and collective combat operations (23:7).

The shock of Pearl Harbor and its aftermath was a costly way to learn the value of tactical air power (2:175). At the beginning of World War II, the AAF was deficient in equipment, personnel, training, and doctrine--particularly in pursuit aviation. The role of fighters in achieving air superiority had been sadly neglected. By far the greatest emphasis was on long-range, unescorted bombers for daylight precision bombing (60:8).

WORLD WAR II

The expansion in the Army Air Force after the outbreak of the second World War meant operational units could no longer be self-training as before the war. Throughout the war, combat units had few sorties to allot to either continuation training or training replacement pilots. Replacements had to be fit for action upon arrival without additional training. Also, the AAF needed a system to meet the increased demand for entire new groups. These training problems led to the development of two systems to train combat ready pilots in the US: Operational Training Units (OTUs) and Replacement Training Units (RTUs) (24:1-2).

The OTU system was based on a British training concept. Certain older, established groups were named as "parent groups." For each parent, the AAF activated

a new "satellite" unit every six weeks. Twenty percent of each new group was experienced personnel from the parent group (23:11-12; 24:280). After 12 weeks of training, the satellite group would be released for overseas service. The last OTU fighter groups finished training in early 1944 (23:17). But the OTU system had accomplished what it was designed to do: provide a means whereby the experience of older fighter groups was made available to newly activated groups (23:14).

The RTU system was created to supply replacements for combat units overseas (23:15). Originally, replacements were obtained by withdrawing qualified personnel from US units, but this was undesirable because of the harmful effect on experience levels in these groups. Therefore, certain groups were designated to be maintained at 50 percent over-strength to train replacement pilots. RTU became the major training method in the US as the problem became less of supplying new units to theaters than of supplying an increasing number of replacements overseas (23:16-17).

The positive effects of the new training system were not apparent early in the war. According to Maj Gen Earle E. Partridge, the "AAF was sadly lacking in its ability to bomb and shoot when the war started. Constant cries from overseas commanders were the same: 'Give us crews who can bomb, shoot, fly formation at high altitude and fly through all kinds of weather both day and night'" (55:11). The training shortfalls were nowhere more evident than in the Pacific where the Japanese were clearly better trained pilots. Americans lacked training in air-to-air tactics and suffered sizeable losses in pilots and aircraft (54:10). The only area where American fighter pilots excelled in aerial combat from the start was the China-Burma-India theater. The small volunteer group called "The Flying Tigers" under Gen Claire Chennault's leadership fought the Japanese to a standstill. Chennault had advocated bold theories and tactics for air combat maneuvering in prior years, but his attempts to increase training were ignored. His unpopular ideas branded Chennault as a non-conformist and forced him into pre-war retirement, only to be brought back when the war started (54:11-12).

The character of fighter training during World War II was established at Headquarters AAF and issued in the form of "training standards" (23:24). The US training commands were given considerable autonomy to train the pilots to meet these standards (24:285). The first of these, AAF Training Standard 10-1-1 (1 December 1942) included these proficiency goals: (1) rapid takeoff and rejoin from dispersed locations, (2) precision landings in rapid succession, (3) formation flying, (4) penetration of weather to clear air on top, (5) descent and landing through an undercast, and (6) execution of offensive and defensive tactics against air and ground threats. Realism was encouraged to "minimize the shock of transition from training to combat operations" (23:34-35). Specific missions included transition and familiarization, formation, gunnery, bombing, acrobatics, individual combat, instruments, navigation, night flying, and high altitude flying. The standard required 50 hours per month for each of 3 months prior to deployment overseas. In actuality, pilots frequently left for overseas units with only 40 hours of flying experience in their assigned fighter (23:36).

Despite these standards, theater commanders complained throughout the war about the quality of their replacements. The most frequent areas of concern were maximum performance flying (maximum load, maximum range), acrobatics, simulated aerial combat, instruments, very high and low altitude flying, night flying, formation, and gunnery (24:291-301). Furthermore, AAF training was not theater-specific (24:286). Since the early AAF Training Standard clearly stated the requirements, the fault appeared to lie

with the RTUs which did not train crews up to the required standards (24:305). Reasons for this included an over-concern with safety and a lack of realism in training. As these were "mutually contradictory," and because of the high accident rate during training, safety won out over realism (24:288-289).

In 1943, the quality of training began to be enhanced through greater theater-specialization, the use of combat returnees as instructors, and lengthened training programs (60:10; 23:63). In October 1944 the AAF Training Standard was revised. The most distinct changes called for a thorough knowledge of individual combat techniques, unit combat and mutual support, and a bomber escort capability (24:303).

Through the early part of the war, basic AAF doctrine relied on the theory that heavy bomber aircraft, flown in massed and self-defending formations, could successfully penetrate enemy defenses and perform precision daylight bombing attacks. Alarmed by the increasing success of the Luftwaffe fighters, the Combined Chiefs of Staff in 1943 decided to step up the bombing of the German fighter forces and the industry that supported them. They also ordered more and improved long-range fighter escorts (1:77-78). Another result of the attrition suffered in the strategic bombing campaign was an attempt in late 1943 to systematize and increase joint training between US fighters and bombers. Such training consisted of using fighters as bomber escorts and as interceptors against attacking bomber formations. Combined training had been flown before the war, but lapsed because of training specialization and the pressing need for additional combat units overseas. The proficiency level of both fighter and bomber crews in operational units was so low that joint training was not considered much value when compared to individual training. On 13 October 1943, a training standard was issued which required intercepts and attacks on bomber formations and 2-hour escort missions above 20,000 feet (23:38-44).

POST-WORLD WAR II

Following the war, Gen Tooey Spaatz, the first Chief of Staff of the United States Air Force, faced the problem of salvaging some air power in the face of the great demobilization and decrease in air strength. He viewed the Air Force mission as two-fold: as a long-range striking force against the enemy's industrial and war-making potential and as a force able to expand rapidly from peace to war (1:109). The reality of atomic war urged strategists to re-evaluate all military forces. The US armed forces were reduced in size and a heavy emphasis placed on atomic weapons. Air strategists argued that nuclear weapons made large conventional armies obsolete because they could not survive (4:1). Although many in the USAF argued to maintain conventional forces based on the likelihood of a conventional limited war, budgets were tight. Leaders gave the first priority to the "backbone of our Air Force--the long-range bomber groups" of the Strategic Air Command (1:109). The explosion of a nuclear device by the Soviet Union in 1949 confirmed the logic of emphasizing forces capable of deterring or winning a general nuclear war (4:1).

The effect of this philosophy was to diminish the size and importance of the Tactical Air Command (TAC) and increase the emphasis on the strategic air defense of the US. Tasked to thwart a nuclear attack from Soviet bombers, the Air Defense Command (ADC) was given some fighter groups from TAC. Most TAC air units were assigned to overseas commands (1:114). TAC's primary mission became close air support

for army units capable of world-wide deployment (1:104-105). Adding to reliance upon strategic forces was the fact that as late as 1949, fighter capabilities clearly lagged bomber performance. Jet fighters lacked the range to escort bombers such as the B-29 and B-36. Interceptor tests flown by the 1st Pursuit Group indicated that the P-80 had difficulty intercepting a B-29. As the speed of bombers and fighters increased, "dogfighting" between aircraft would be "impossible" and intercepting fighters might be able to make no more than a single head-on pass against a bomber (1:118). The future of TAC was in jeopardy. Even leaders in TAC were pessimistic. In 1948, Colonel William W. Momyer (later to become Commander of TAC) pointed out that TAC would become involved in hostilities only if our atomic offensive failed and war degenerated into an unlikely conventional conflict. He expected TAC's fighters to pass to operational control of ADC at the onset of hostilities to perform air defense. He further questioned the use of jet fighters as escorts as an obsolete concept from World War II (1:123). In December 1948, the Air Force established the Continental Air Command as a superior headquarters to TAC and ADC (1:124).

Predictably, training for US-based fighter units had been severely curtailed due to a lack of funds and low priority during the 1948 to 1950 austerity program. Training directives established unrealistic training programs which gave only token lip service to any conventional warfare training, not to mention aerial combat. A typical directive of the period was Continental Air Command Training Standard No. 10-3 (17 March 1950): "The F-84 pilot will be trained to a standard enabling him to handle his aircraft with skill and confidence. The pilot will meet and maintain proficiency in. . . employing effective techniques and tactics in air-to-air combat" (59:10-11). However, no program or manual was available to define effective techniques and tactics in air-to-air combat. "Either a pilot knew tactics already or he was to learn them pretty much on his own" (59:11). Thus, one finds a definite relationship between national policy (reliance on the nuclear deterrent) and the types of tactical training. From 1948 to 1950 there was practically no conventional weapons delivery training because advocates of strategic airpower felt it a waste to train in this area (59:18).

KOREA

The invasion of the Republic of Korea by North Korea on 25 June 1950 caught the USAF largely unprepared for a conventional, limited conflict. The Far Eastern Air Force (FEAF) was hampered at first by the fact that it was equipped and trained for the air defense of Japan rather than for offensive employment in Korea (1:148). A participant in the conflict, Lt Col Ralph S. Parr, remarked, "Ironically, the richest nation in the world had some jet pilots flying combat, in the early days of Korea, with football helmets and makeshift earphones. This was after four years of jet fighter units" (54:14).

The first task of the USAF was to rejuvenate an air force that had been allowed to atrophy since World War II. This involved a massive reorganization of air units, activation of reserve units, and restoration of tactical aircraft from mothballs. To stop the ground advances of the North Koreans, the FEAF instituted a close air support (CAS) and interdiction campaign. To succeed, however, the first task was to obtain air superiority--an objective not capable of being attained by a strategic bombing campaign because of political constraints (2:301). As Gen Momyer recounted, "Just as achieving air superiority was the first concern in World War II, it also became the top priority mission in the Korean War" (4:113).

Fortunately, the US had time to prepare and train. The principle air mission early in the war was to prevent the enemy from overrunning UN ground forces through the close air support and interdiction campaign (1:152). Also, the communists did not commit the MiG-15 in concentration early in the conflict. By the same token, using their sanctuary north of the Yalu, the communists were free to build up their Manchurian airfields with MiG-15s and began to fly combat sorties into Korea in November 1950, in preparation for the Chinese counterattack later in the month (1:149). As more MiGs appeared over North Korea to threaten the CAS and interdiction aircraft, the F-86 was committed to the battle (59:12). The F-86 was designed as an "air superiority fighter" and arrived in Korea in December 1950 with the 4th Fighter Interceptor Wing. Combat duties were divided up with the F-86s assigned the role of containing and eradicating MiGs using air patrols near the Yalu. Other USAF aircraft (F-51s, F-80s, and F-84s) provided tactical support to ground forces (8:1188).

The F-86 and the MiG-15 were very closely matched, although the MiG was considered superior in many respects (45:61; 50:10). However, the F-86 scored a crushing victory over the MiG--a kill ratio of 10 to 1--and was able to maintain air superiority throughout the war (50:10). This success was a result of the experience of World War II combat veterans and the development of a superior training program (54:14-15). In his end-of-tour report as 4th Fighter Interceptor Wing Commander, Col Harrison R. Thyng praised the stateside training of his pilots, who were 60 percent second lieutenants out of flying school at Nellis. Col Thyng stated they were superbly trained upon arrival especially in weather, formation, and gunnery. He went on to say, "I wish I knew how or why we can maintain against 6 to 1 odds a victory ratio of 8 to 1... We have the odds in our pilots. I am hopeful that that is the difference in the victory ratio. The training and courage of these airmen has completely amazed and bewildered the enemy" (21:2,8).

During the Korean conflict, the USAF began a trend toward specialized fighter pilots. The preponderance of fighter operations in Korea was ground attack. The FEAF reorganized units consistent with the various missions and with the optimum capabilities of its aircraft: F-80s, F-84s, and F-51s for interdiction and CAS; F-86s for air superiority. The need for specialized pilots led to a reorganization of training programs in the states--fighter-bomber training at Luke and Williams AFBs and air combat training at Nellis. In the states, there was some skepticism about specialization. Students at Luke were no longer required to maintain proficiency standards in aerial gunnery and the fear was raised that ground attack pilots would be unable to defend against MiGs (45:15-25).

At Nellis, F-86 training emphasized missions designed to simulate the combat conditions in Korea. Academics included the theory of aerial attack, fighter operations, gunsight fundamentals, aircraft harmonization, and identification of friendly and enemy aircraft (59:11-12). With the trend to greater specialization, the syllabus increased its emphasis on preparing for aerial combat in Korea: intercepts, aircraft handling, and gunnery performed at high altitude and high speed (45:20-21). Table 2 summarizes the October 1952 F-86 course of training at Nellis AFB.

Training Mission	Sorties	Hours
Familiarization and Orientation	8	6:50
Local area orientation		
Acrobatics		
High altitude handling		
High speed handling		
Night transition		
Formation and Navigation	10	8:20
Close formation		
Combat formations		
High altitude formation		
Four-ship formation		
Instruments	5	6:00
Air-to-Ground Gunnery	11	9:10
Air-to-Air Gunnery	22	18:20
Camera gunnery		
Live firing		
(15,000 to 30,000 feet)		
Applied Tactics	30	31:20
In-trail acrobatics		
Tactical formation		
(25,000 to 35,000 feet)		
Ranging and tracking vs. high-speed target		
Fighter vs. fighter		
(25,000 to 40,000 feet)		
Fighter instruments		
Fighter sweep		
Ground attack		
Night navigation		
Maximum radius of action missions		
(Escort, intercepts, sweep)		
TOTALS	86	80:00

Table 2. F-86 Training Syllabus, October 1952 (30:--)

POST-KOREA

Despite the aerial combat successes in Korea, and the apparent re-learned lesson of tactical air superiority, aerial combat training in TAC diminished after 1953. Several factors accounted for the decline.

After Korea, a popular view existed that we should never fight nor prepare to fight another war like Korea. Some argued, if a limited war broke out, nuclear weapons could end it quickly. Thus, limited conventional wars were unlikely and aerial combat would also be unlikely. This idea was conveniently used to justify a reduction in defense expenditures (4:6). The 1950s doctrine of "massive retaliation" to deter aggression was a response to the very real limits on the amount of national resources that could justifiably be committed to weapons production (1:213). USAF doctrine relied upon nuclear deterrence (60:14). TAC, therefore, began to prepare for a nuclear role (59:22).

A second factor affecting the role of tactical air power was the development in 1950 of atomic weapons capable of carriage and delivery by fighter aircraft. In 1951, Project Vista, an influential Air Force study of the problems of tactical air warfare, concluded that while the battle for air superiority would be overwhelmingly important, it could be achieved by a concentration of tactical atomic weapons against Soviet airfields. Air-to-air fighting did not promise to be very effective. Bombers should rely on high speed, low altitude, weather, darkness, and countermeasures rather than fighter escort (1:167). In light of these developments, a gradual reorientation of USAF fighter aircraft and training toward the nuclear mission took place. The F-105 was developed as the first fighter-bomber with an internal bomb bay, emphasizing penetration capability and load carrying ability rather than maneuverability and armament (60:15).

A third development was the growing awareness of a capable Soviet nuclear bomber threat. Preoccupation with air defense of the continental US resulted in heavy emphasis on all-weather fighter interceptors and a de-emphasis in tactical aircraft (60:15). A long succession of air defense interceptors were procured to counter the Soviet threat: the F-89, F-86D, F-94, F-102, and F-106 (1:162). These interceptors were compatible with the SAGE air defense system and were capable of a high probability of single-pass destruction of hostile bombers (1:268,269,284).

Finally, several growing trends in aircraft development reflected the prevailing view of conventional air warfare. New fighters would rely on speed, long-range missiles, and airborne radar. Through greater performance, early radar acquisition, and long-range missiles, aerial combat would become "automated"--maneuvering combat was no longer appropriate (8:1189). The US Navy expressed the opinion that modern fighters employing long-range guided missiles would not be subjected to highly maneuvering "dogfights." The F-4 was developed by the Navy without an internal gun. The USAF accepted these concepts and also procured the F-4, which became the workhorse in Southeast Asia (1:343).

The effect on training was predictable. Tactics and training in TAC became oriented to the nuclear mission: low-level navigation and nuclear weapons delivery (60:15). Conventional weapons delivery training was secondary, and aerial combat tactics training "all but faded from the scene. Nuclear training requirements were so many and burdensome there was little time left for anything else" (59:22). Several tactical fighter pilots recalled from personal experience the lack of air-to-air training.

In several Air University research papers, the authors stated that during the late 1950s and early 1960s a requirement did not exist for even one ACM (Air Combat Maneuvering) training sortie in most operational tactical fighter units (51:8; 60:15).

In the early 1960s, the Cuban missile and Berlin crises generated an increased interest in conventional weapons capabilities as part of the "flexible response" doctrine. Tactical fighter training programs were revised and flying time was abundant, but ACM training still did not expand accordingly (52:25-26; 60:16). Combat ready TAC fighter pilots received about 250 hours of flying (about 200 sorties) per year. Missions included formation, instruments, navigation (high and low altitude), nuclear weapons delivery, deployments, inflight refueling, and aerial tactics. The required number of aerial tactics missions varied by aircraft. F-104 pilots required 5 ACT missions per quarter (about 10 percent of the 50 total sorties flown per quarter). F-4 crews required one ACT per quarter plus 11 intercept sorties against non-maneuvering targets. F-100 and F-105 pilots required 3 ACT missions per quarter (59:39-40). The 1963 version of AF Manual 51-100, "F-100D/F Aircrew Training Manual (Tactical Fighter)," required 3 ACT missions per quarter (about 6 percent of total sorties) and described five mission profiles. Mission #1 familiarized aircrews with fighting wing formation and maximum performance aircraft handling. Mission #2 familiarized the aircrew with "the hazards of overshooting" using a "canned" defensive maneuver for demonstration. Mission #3 introduced elementary offensive maneuvers against a "canned" defensive maneuver. Mission #4 introduced two versus two visual engagements, again with one element flying "canned" defensive maneuvers. Mission #5 was designed to expose aircrews to captive-carry of air-to-air missiles and ground controlled intercepts (GCI) (29:39-41). Despite the progressive nature of these missions, it appears that what little air-to-air training was accomplished was not very realistic (49:15).

WAR IN SOUTHEAST ASIA

As the first USAF combat unit deployed to South Vietnam in June 1962 (2:329), US fighter tactics had not changed appreciably since the Korean War (54:20). The air-to-air capability of US tactical air forces "was, at best, less than optimum." Early engagements in North Vietnam confirmed this fact (16:66).

The air war was greatly restricted in 1963 and 1964, but in July 1965 President Johnson announced an increase in US strength in Vietnam and the USAF initiated a bombing campaign against North Vietnam (2:331,336; 51:9). As the air war in the north grew, neither the USAF nor the US Navy was prepared for aerial combat. The USAF had F-102 interceptors in place, but they never saw combat except for a few isolated incidents (53:57). In 1965, the USAF relied on guided missiles as air-to-air armament. The F-4 became the primary air-to-air aircraft, but like the F-102, it had no internal gun--testimony to the faith in missiles, chiefly the Sidewinder. The effect of Southeast Asia (SEA) combat engagements, however, ended this so-called "Sidewinder myth"--the belief that air-to-air guided missiles would eliminate the need for maneuvering to achieve kills. In the first year of combat, Sidewinders had a 1 for 11 success rate. Originally designed for stern attacks against non-maneuvering targets, the missile was not very successful in the maneuvering engagements over North Vietnam (6:1190).

In March 1966 the air war in the north intensified. Numerous aerial engagements took place between 1965 and 1968 primarily involving USAF F-4 crews. Air-to-air

training, however, continued to reflect the 13-year emphasis on non-air-to-air missions. Even as late as September 1969, AF Manual 51-34, "F-4 Aircrew Training Manual," specified only 6 ACM sorties semi-annually--one per month or about 5 percent of total sorties flown (60:48). The only pilots in the F-4 who were proficient in ACM were Fighter Weapons School instructors, recent graduates, and unit ACM instructors (60:49). In contrast, the Air Defense Command F-106 interceptor pilots required 12 ACM sorties per half, and the US Navy flew up to 20 ACM missions per half (60:50-51).

The air-to-air results were disappointing. USAF pilots downed 81 MiGs and lost 36 friendlies for a 2.25:1 ratio. Most alarming was the poor trend. In 1968, the ratio fell to about 1:1 (19:38). In contrast, the kill ratio in Korea (for all USAF aircraft) was 6.2:1 (19:30). In 1966, the Commander of Seventh Air Force, Gen Moore, requested that the Fighter Weapons School send to SEA a team of instructor pilots in the F-4, F-104, F-105, and F-100 to brief air combat tactics. The results of these briefings and a series of demonstration flights proved that our combat crews were not familiar with air combat tactics nor proficient in maximum performance maneuvering. Deficiencies also existed in proper Combat Air Patrol and escort procedures, and in low altitude aerial combat. It was obvious that many of these areas had been sadly neglected (60:18).

Despite the evidence of training deficiencies, the USAF made little progress. The Air Force expressed some concern for a lack of success in aerial combat and the F-4E was developed as an improved air-to-air fighter over the F-4D (with an internal gun and greater maneuverability). But unfortunately, several accidents during ACT training missions in 1967 and 1968 caused air-to-air training to once again become limited in scope and restrictive in maneuvering (53:59). An emphasis on flying safety made many commanders reluctant to allow maximum performance maneuvering (60:61). In fact, in January 1969, ACT programs in TAC were virtually discontinued. Replacement training units provided minimal exposure to air-to-air (53:33-34). Dissimilar air combat training (DACT) was specifically prohibited by the TAC supplement to AF Manual 51-34 in May 1968 (60:55). The emphasis remained on ground attack. Fortunately, between 1969 and 1971, air-to-air engagements declined as the enemy stood down to rebuild and retrain (51:9).

In contrast with the USAF, the US Navy embarked upon an unprecedented program to improve their air-to-air performance. In mid-1968, a special Navy study group headed by Capt Frank W. Ault analyzed every US Navy aerial engagement in SEA. After looking at every factor (including weapons system procurement, training, logistics, and operations), the Ault Group concluded that the Navy needed to train aircrews better for aerial combat (19:25). The Navy founded the TOPGUN Fighter Weapons School in late 1968 and began an aggressive DACT program (53:58). The effort paid off. Through 1968, the Navy kill ratio had been 2.4:1. Following the creation of TOPGUN, the Navy shot down 25 MiGs while losing only 2 friendlies, a 12.5:1 ratio (19:38).

By 1971, TAC was beginning to realize the necessity for realistic air-to-air training. In November 1971, the USAF Fighter Weapons School hosted a joint command and service working conference on ACT training concepts. At this time, only 5 of the Weapons School instructors were ACT qualified. By the end of 1972, TAC began to revive the ACT program (53:61-62). Between August and December 1972 the Weapons School taught an ACM course for SEA-bound crews just out of F-4 upgrade training (51:9). While the efforts in 1972 produced some post-war training programs, the success

rate in SEA was not greatly improved: a kill ratio of 1.92:1 from 1971 to 1973 (19:38). It appeared that the efforts were too little, too late.

The lessons of SEA were all too familiar. The US had once again entered a conflict deficient in air-to-air proficiency (51:12). Because of the lack of training, aerial tactics had not changed perceptibly since the Korean War ended (54:20). The importance of tactical air superiority had once again been underestimated (60:71). Despite the tremendous technological advances in weapons and fire control systems, success often depended on the outcome of turning engagements (8:1189). The results of SEA also spawned a growing concern over multi-mission aircraft and the lack of specialization in training (60:69). As a result, TAC began an era of increased emphasis on air-to-air training, Dissimilar Air Combat Tactics (DACT) training, the Aggressors, Red Flag, and increased specialization (9:79).

POST-VIETNAM

The lessons of SEA were not soon forgotten. In November 1972, TAC held a Tactical Fighter Symposium at Nellis AFB concluding that both tactics and training needed thorough review based on combat in SEA. Training recommendations included the following: (1) Training should be optimized--the number of roles for multi-purpose aircraft should be reduced. Units should concentrate primarily on either air-to-air or air-to-surface, but not both. Sorties and events, not flying hours, should be used to measure flying training. (2) Training realism should be enhanced by providing an authentic warlike environment during training (16:66-70). The Air Staff then appointed the Force Capability Employment Group chaired by the USAF Director of Operations to monitor and expedite the symposium recommendations. A number of programs resulted from these efforts including the Fighter Lead-In Training program, the Aggressors, and the Air Combat Maneuvering Range (ACMR) (58:9).

In January 1973, the tactical major commands met at Headquarters TAC to develop an optimized aircrew training program and evaluation criteria (61:5-6). This meeting proposed that air-to-air units fly 70 percent air-to-air, air combat tactics be a pass/fail item for air-to-air units in Operational Readiness Inspections (ORIs), and that a test program be initiated involving two F-4 squadrons from each command: one specializing in air-to-air and one in air-to-ground (61:6). As a result of this meeting, the entire operational training system was realigned (16:70). In July 1974, revised multi-command 51-series training manuals were published for each type aircraft (51-34 for the F-4) (58:9). The operational capability of each squadron was designed to optimize training in either a primary air-to-air or air-to-surface role. These roles were called Designed Operational Capabilities (DOCs). Every multi-purpose squadron (F-4) had a primary and a secondary DOC. Sorties were broken down based on three aircrew proficiency levels: (1) "Basic Proficiency" required only qualification in basic flying skills such as instruments and night flying, but no weapons training. (2) "Mission Capable" would require a minimum of additional training before combat. Formal training in weapons employment was provided, but at a reduced level. In this category were staff and supervisory personnel. (3) "Mission Ready" aircrews were prepared for combat and maintained full training requirements (16:70-71).

The new training concept was first implemented in the 4th Tactical Fighter Wing at Seymour-Johnson AFB beginning in July 1974. Assigned a primary DOC of air-to-air,

the wing embarked upon a stair-step approach. Based on SEA lessons, the training program included improved training scenarios and new proficiency exercises. Academics were patterned after the F-4 Fighter Weapons School and included enemy threat, environment, and weapons employment. Flying was progressive, beginning with Basic Fighter Maneuvers (BFM) including dissimilar BFM against the Aggressors flying T-38s. Other basic training included gun tracking and agility exercises designed to achieve weapons parameters within time criteria. BFM was followed by Air Combat Maneuvers (ACM) to stress element coordination and radio communication. Air Combat Tactics (ACT) missions integrated lessons learned from previous phases and provided the arena in which overall air-to-air capability was measured (16:70-73). Two years after the beginning of this program, then-Col Robert D. Russ, 4th Tactical Fighter Wing Commander, reported greatly improved air-to-air effectiveness "accomplished without compromising safety; indeed, its cause [safety] has been promoted by the structural nature of the training and the increase in proficiency of the aircrews" (16:74).

All was not rosy, however, under the AF Manual 51-34 system. Following the fuel crisis in 1973, flying hours and sorties decreased to the minimum required to maintain proficiency in specified training events (52:27). TAC increasingly emphasized the quantity of events accomplished to the detriment of the quality and realism of the training (58:2). Emphasis on the 51-34 events displaced the achievement of subjective skills necessary for combat capability in the tactical environment (52:27). Rather than using the manual as a guideline for training goals, the achievement of minimum numbers of events made the training system an end in itself (56:30). Proficiency came to be defined by the accomplishment of a certain number of "squares," often filled with marginal effectiveness due to pressure to obtain the minimum number. The program became a scheduling nightmare. Integrity was suspect:

> It seemed that no matter how few sorties some aircrews flew, the training would still be accomplished. At some units, no matter how many additional specialized missions were absorbed, all aircrews were still able to accomplish the additional training without an increase in sorties. . . . Unfortunately, the aircrew felt the pressure intensify with each lower echelon of command and at least some aircrews filled most of their squares with marginal effectiveness (18:9).

As a result of problems with AF Manual 51-34, TAC published a new training manual in October 1976: TAC Manual 51-50, "Tactical Fighter/Reconnaissance Aircrew Training." TAC Manual 51-50 was built around the concept of Graduated Combat Capability, or GCC (52:29). Under the 51-34 DOC system, an aircrew had to fly a specified number of sorties and events over a six-month period to be considered proficient in the use of the weapons system. Failure to achieve the specified number caused regression to a non-Mission Ready status (5:4). GCC training was "subtly different." The new philosophy stated if an aircrew flew a given number of effective sorties, using scenarios that necessitated the performance of real-world tactics, he would be considered proficient and, therefore, "combat ready" in that mission (5:4; 18:9). Furthermore, commanders were given the latitude of assigning aircrews a "graduated" combat capability rating (A, B, or C) in a particular mission category (such as air-to-air) reflecting that aircrew's proficiency (based on the number of effective sorties flown) (18:9). Quoting from TAC Manual 51-50, Volume I, 1 October 1977: "Tactical Training should emphasize the employment of basic skills in realistic training scenarios/profiles. . . . Such unit developed scenarios should encourage innovation in the use of all UE

[Unit Equipped] systems, and should permit the maximum full play and employment of tactical concepts and practices" (52:29).

Despite the publication of a new training manual, some problems still plagued TAC training. As in 51-34, pressure to attain the minimum number of effective ("GCC") sorties, especially in light of a continuing decrease in flying time in the late 1970s and early 1980s, led to decreased not increased proficiency. The loophole in 51-50 centered around the word "effective." "Because it became distasteful for a unit to report lower GCC levels, 'effective sorties' were unofficially reduced to 'sorties'" (18:10). Guidance was muddled over how well a sortie was flown to be effective, but abundantly clear about how many were required. The whole emphasis evolved into getting the "squares" (sorties) accomplished, with little interest in how well the sorties were performed. As with 51-34, the achievement of quantity assumed that quality would automatically follow--this led to a false sense of proficiency (18:11).

Based on a survey of Red Flag participants from 1976 to 1977, an F-4 Fighter Weapons School instructor stated, "The underlying feeling expressed by aircrew members indicates that the training in daily unit activities is not at a level necessary to gain more than exposure to a high threat from Red Flag participation." Problems included canned ACT training, over-concern about accident potential in realistic scenarios, and "filling squares vice tactics training" (52:11). Another problem came to light during Aggressor visits to F-4 units. Fighter Weapons School instructors who accompanied the Aggressors noticed a lack of proficiency in the basics, namely BFM and ACM. The necessity of filling training squares overcame the value of a progressive program of training--building BFM and ACM skills as a prerequisite to tactics missions (52:35).

SUMMARY AND CONCLUSIONS

Efforts to prepare for aerial combat have battled through years of doctrinal debate, peacetime demobilization, and tight budgets. Despite the preponderance of predictions to the contrary, each of the four US wars in this century demanded the attainment of air superiority--in each case by tactical fighters engaging in air-to-air combat with enemy fighters. There can be no doubt that tremendous progress has been made--it appears that TAC no longer must argue the need for tactical air superiority and realistic training to prepare for it. Never before have we enjoyed such training experiences as Red Flag, the Aggressors, ACMR, and DACT. In the last three or four years, the decreasing trend in flying time has reversed. The present combination of flying time and realistic scenario training has reached a level hoped for but never achieved in the past.

Yet recurring problems still plague efforts to produce the very best air-to-air aircrews. A number of factors hinder the ability of squadrons to plan and execute demanding and realistic training programs. TAC Manual 51-50 is still in effect, but it has become another "scheduling nightmare." To ensure the continuation of quality air-to-air training demands a critical examination of training guidance and a continuing effort by every squadron tasked for air-to-air to produce the kind of progressive, performance-oriented training program described nearly 60 years ago in War Department Order AG-353.

Chapter Three

CURRENT STATUS OF AIR-TO-AIR TRAINING IN TAC

Today, TAC arguably enjoys the best air-to-air training ever in the history of US airpower. Programs such as Red Flag, Aggressors, DACT, Air Combat Maneuvering Range (ACMR), and Checkered Flag are unprecedented training media. The availability of spare parts and flying time have driven aircraft utilization rates to the highest levels in a decade, and official guidance expresses a strong orientation toward combat capability. TAC Manual 51-50, "Tactical Fighter/Reconnaissance Aircrew Training", states, "MAJCOM/unit training programs are designed to achieve the highest degree of combat capability within available resources" (40:1-2).

The responsibility for air-to-air training rests largely with the squadrons. According to TACM 51-50, training programs "should be managed at the squadron level. . . as much as possible" (40:6-1). TAC Regulation 55-79, Chapter 10, "Air-to-Air Training," echoes this: "Each unit commander will be responsible for establishing and maintaining a unit air-to-air training program" (33:10-5).

Unfortunately, there are indications that squadrons are not always successful in fulfilling their responsibility to "establish" and "maintain" unit air-to-air training programs. In interviews with squadron commanders, flight commanders, and weapons officers at the three operational TAC F-15 wings, the author discovered a consistent feeling that squadrons face considerable difficulties in planning their training (63:--; 64:--; 65:--; 66:--; 68:--; 70:--). These include external factors as well as problems within the units. The effect is a degradation in both the quantity and quality of training sorties.

It is beyond the scope of this project to identify, analyze, and solve every problem with air-to-air training today. Therefore, this chapter focuses on three of the most significant external hindrances to squadron training plans: TACM 51-50, the evaluation process, and flying time management. The author has considered and will mention a number of others. Acknowledging these difficulties, Chapter Four provides some suggestions to help squadrons plan and execute training programs.

TAC MANUAL 51-50

TAC Manual (TACM) 51-50 was adopted in 1976 to overcome some significant shortcomings with its predecessor, AFM 51-34: specifically the emphasis on event accomplishment ("square-filling") to the detriment of realistic training scenarios (58:2). TACM 51-50 originally emphasized that if an aircrew flew a given number of "effective" sorties built around real-world scenarios he would be "combat ready" (5:4; 18:9). However, in practice TACM 51-50 has grown so large and complex that "square-filling"

has supplanted realistic and progressive training programs--much as the regulation it replaced (63:--; 65:--; 66:--). This analysis will examine these issues: event accomplishment and complexity.

Event-Oriented Training Requirements

TACM 51-50 provides a mix of sortie types and events to form the basis of the unit training program. Tables 3 and 4 represent the sorties and event requirements in TAC F-15 wings based on TACM 51-50 and semi-annual TAC training messages (28:--; 40:--). The training approach in TACM 51-50 calls for units to "develop mission scenarios" which "should emphasize realistic simulated combat profiles" (40:1-2). However, there are a number of reasons why event requirements detract from a realistic training program.

In general, event training tends to fragment the training program. Completing a number of training events in isolation "does not provide the degree of training necessary to maintain proficiency required to operate effectively in combat" (56:39). On the other hand, a training program requiring a number of basic missions building up to tactical missions using realistic scenarios provides a unified and progressive method to reach the desired level of capability.

Event-oriented training performed in isolation from realistic scenarios removes those skills from the context of the overall mission (52:30). Tactical events are required presumably because they represent a skill necessary to accomplish a tactical mission. Were this not the case, the event would not be required. For example, the requirement for a "high day intercept" indicates a belief that that skill will be required to accomplish a mission. Instead of the event, however, requiring a mission scenario in a realistic threat environment encourages the employment of the event in order to achieve the mission goals. Far more can be gained by requiring a "point defense against high threats" than by merely requiring a high day intercept. On the other hand, if that type of scenario is not a realistic wartime scenario, then the event is unnecessary. Additionally, because of the variation in unit tasking and theaters, units need the flexibility of creating and flying an appropriate mix of scenarios.

Requiring an event in isolation of an expected wartime scenario forces the unit to take time out of tactics missions to fly the event. "Square-filling" to fly the events is encouraged rather than realistic training. Moreover, just as in the case of AFM 51-34, the pressure to obtain the events because they are required by the training manual increases the emphasis on events versus missions and scenarios (18:10; 52:11).

For events that naturally fall out from realistic scenarios, tracking the events is an unnecessary workload. For example, Table 4 shows the requirement for 12 "RWR" (Radar Warning Receiver) events accomplished by observing and reacting to an RWR-displayed threat. Since operational F-15s are equipped with RWR, this event is a routine occurrence during tactical missions and, therefore, unnecessary to track. Similarly, there is little need to track Have Quick, ECR Profiles, Jamming, and Chaff events since realistic scenarios encourage the use of these systems. As another example, night landings need not be tracked if night sorties are required.

Event requirements shift the emphasis of the training program from attaining a level of proficiency based on performance, to achieving a specified number of events.

Sorties	Requirements Inexperienced	Experienced
Basic Requirement:		
Total Sorties	30	30
Instrument Sorties	2	0
Night Sorties	2	2
Simulator Hours	12	9
Level A Requirement:		
Total Sorties	50	46
GCC Total	40	36
GCC Mix:		
ACBT	31	27
Day Intercept	2	2
Night Intercept	3	3
Dart	1	1
LOWAT	3	3
Collateral Sorties	10	10

Table 3. TACM 51-50 Semi-annual Sortie Requirements (35:3-1; 40:A1-3,6-45,A1-3)

The objective of the training program tacitly becomes filling the squares in the manual vice producing proficient aviators by the end of the cycle (56:30). TACM 51-50 does not specify how well an event (or sortie) must be accomplished to count, just how many must be flown (18:10). The incentive is to get the squares accomplished no matter how well or poorly performed. However, combat capability and mission ready status cannot be measured by how many sorties or events are flown "but by demonstrated performance on each sortie" (52:27,28,54).

Events	Requirements Inexperienced	Experienced
Formation Takeoffs	4	4
Instrument Events:		
Penetrations	6	6
HUD-off Penetrations	3	3
Precision Approaches	18	12
HUD-off Prec Approaches	9	6
Non-Precision Approaches	18	12
HUD-off Non-Prec Approaches	9	6
Night Landings	2	2
Air-to-air Refueling	3	3
Night Refueling	1	1
ACMI	4	4
Intercepts:		
High Day	4	4
High Night	2	2
Low Altitude	10	10
No GCI Day	4	4
No GCI Night	2	2
VID	1	1
Snap-up/Fly-up	2	2
Alert Scramble	1	1
Scenarios:		
Point Defense	2	2
Escort	2	2
Sweep	2	2
CAP	2	2
Low Level Navigation	4	4
Low Level Tactical Formation		
Line Abreast	4	4
Wedge	4	4
Have Quick	6	6
ECM/ECCM Events:		
ECR Profiles	12	12
Jamming	3	3
Chaff	3	3
RWR	12	12
Close Formation	12	12
Chemical Warfare Exer Flight	1	1

Table 4. TACM 51-50 Semi-annual Event Requirements (28:---; 40:3-2,6-45)

Complexity

TACM 51-50 has become a very large and complex document, especially in comparison with its predecessor, AFM 51-34. Whereas in 1973 AFM 51-34 contained 1 volume, 4 chapters, and 14 pages for the multiple-mission F-4, TACM 51-50 today contains 2 volumes (I and VII), 10 chapters, and 97 pages containing information for the single-mission F-15. The manual has grown so long and complex that training management and scheduling are very difficult. Tracking procedures do not always provide timely information for decision-making because of the large amount of data. Unofficial, duplicative "grease board" tracking methods are routinely used to provide timely and accurate training and scheduling inputs (63:--; 64:--; 65:--; 66:--; 70:--). In addition to tracking the sorties and events from Tables 3 and 4 for as many as 40 pilots, squadrons also track currencies for the events in Table 5. In one F-15 wing, the training printout for each pilot is 16 pages long (27:--).

One reason for the length and complexity of TACM 51-50 is duplication. For example, training requirements are repeated in two TACM 51-50 tables (3-1 and 6-14) (40:3-2,6-45). An explanation of the training policy of "realistic simulated combat profiles" is repeated in at least three different locations: Volume I Chapter 1 and Chapter 6 (twice) (40:1-2,6-2,6-24). Some sections seem to be unnecessarily long and involved: the proration method is now explained in six paragraphs. AFM 51-34 used one paragraph (25:4-3; 40:3-3).

It seems that 51-50 has grown too long, repetitive, and detailed for use in planning and executing squadron training plans. More effort is expended in "keeping up" with the document (scheduling and monitoring sorties, events, and currencies) than in planning an integrated program designed to reach specified levels of combat capability measured by actual performance. Because of the level of detail, squadrons have little latitude in adapting training programs to their specific contingency areas, missions, experience levels, airspace constraints, and scheduling commitments (70:--).

Recommendations

The author recommends a complete re-write of TACM 51-50 to include the following suggestions in an effort to place more of the responsibility and authority for training at the squadron level:

1. Eliminate the tactical event requirements summarized in Table 4.
2. Establish minimal sortie requirements such as in Table 13 in Chapter Four of this paper. Allow units to publish appropriate training scenarios based on squadron wartime tasking.
3. Simplify and shorten the manual. Eliminate duplication and reduce complexity.

EVENT/SORTIE	CURRENCIES Inexperienced	Experienced
Flying Training:		
Day Landing	30 Days	45
Night Landing	15	30
ACBT	90	90
Formation Takeoff	60	90
Formation Landing	60	90
LOWAT	60	90
Aerial Refueling	6 Months	6
Flight Lead Wing Takeoff	6 Months	6
Flight Lead Wing Landing	6 Months	6
Dart Sortie	18 Months	18
Ground Training (all pilots):		
Egress	90 Days	
Hanging Harness	180 Days	
Flying Safety Meeting	Quarterly	
Intelligence Testing	Semi-annual	
Weapons Testing	Semi-annual	
Instrument Test and Check	Annual	
Qual Exam and Check	Annual	
Tac Exam and Check	Annual	
Wet Drill	Annual	
Survival Equipment	Annual	
Local/World Survival	Annual	
Chem Warfare Refresher	Annual	
Checkered Flag Verification	Annual	
Chem Warfare Exercise	Annual	
Physiological Training	3 Years	

Table 5. TACM 51-50 Currencies (28:--)

THE EVALUATION PROCESS

The success of a flying training program is evaluated using two principal means: Standardization and Evaluation (Stan Eval) checkrides and Operational Readiness Inspections (ORIs). In addition, several non-flying evaluations have a significant if indirect impact on unit flying training. These include Management Effectiveness Inspections (MEIs) and Stan Eval Visits.

The Impact of Evaluations on Training

In an Air Command and Staff College thesis, Maj (now Col-selectee) John Jumper, a former F-4 Fighter Weapons School instructor and F-16 squadron commander, assessed the influence of evaluations in this way: "The requirement to pass annual checkrides and ORIs in peacetime is as much a threat to survival as real bullets and SAMs [Surface-to-Air Missiles] in combat. It is prudent to expect that training will be geared to insure this survival" (52:80). He continues by stating that evaluation criteria represent the standards for training--the level of combat capability expected from a unit or individual--and, therefore, exert a significant influence on the conduct of peacetime training (52:83,84,88).

> However, one of the most difficult problems is learning how to balance the training emphasis with the demand of the projected threat and the more immediate threat of checkrides and ORIs. Training cannot be progressive unless it is sensitive to the criteria by which aircrews will be evaluated, and the evaluation process must test the final product of training. Hence the dilemma that faces the TAF [Tactical Air Forces] today. . . (52:28-29).

Thus, the character of a squadron program will necessarily reflect the evaluation criteria in TACR 60-2, "Aircrew Standardization/Evaluation Program," and AFR 123-1, TAC Supplement 2, "TAC Operational Readiness Inspections."

Stan Eval Checkrides

TACR 60-2 states, "The overall goal of the Stan/Eval Program is to provide commanders with meaningful indicators reflecting aircrew training and capability to perform the unit mission" (38:2-1). This is achieved during aircrew flight evaluations that "measure the examinee's proficiency at accomplishing a given level of Graduated Combat Capability (GCC). . . . Tasking will reflect unit daily training missions, be realistic, incorporate current tactics, and be in concert with unit Checkered Flag Tasking" (38:4-2).

In the opinion of a number of F-15 weapons officers who are tasked by TACR 55-79 with the responsibility for administering squadron training programs, Stan Eval checkrides are generally not responsive to unit training as mandated in 60-2. While considerable variation exists among different F-15 wings, the principal breakdown is a failure by both the wing and the squadron to establish specific performance standards toward which squadrons orient their training and by which Stan Eval assesses capability. (A more detailed discussion of "measurable objectives" and "performance standards" is provided in Chapter Four.) Moreover, there is often little coordination among wing Stan Eval, squadron weapons, and squadron training about the actual

contents of the squadron training program (63:--; 65:--). The result is a disconnect between daily training and the formal means of evaluating individual combat capability.

More specifically, when the squadron sets the goal of training toward proficiency at a specified level (for example, 4-ship employment), Stan Eval checkrides seldom, in the author's experience, evaluate performance at that level (during "4VX" missions). Most tactical checkrides are given on 2V2 similar Air Combat Tactics (ACT) missions. Furthermore, while 60-2 requires examinees to be evaluated at "a given level of Graduated Combat Capability," performance standards for checkrides do not reflect different GCC levels (38:4-2).

In summary, even with an active Stan Eval program using realistic scenarios for evaluation, there is room for improvement in establishing mutually accepted performance standards, progressive criteria for higher GCC levels, and more dialogue between those who administer training programs and those who evaluate combat capability.

ORIs

In accordance with AFR 123-1 TAC Supplement 2, an ORI is "designed to assess the degree of a unit's operational readiness--its ability to perform the wartime/contingency mission" (37:10-1).

ORI scenarios and evaluation criteria have improved considerably over the last few years (63:--). However, there is one negative influence on training, especially during local sortie surges and wing-directed practice ORIs: Air Defense Alert. Paragraph 10-31, "Air Defense Alert," states, "Units with tasking in air defense alert will demonstrate proficiency in intercepts" (37:10-41). The typical mission in this phase is a scramble departure, single intercept ("hack"), and return to base (RTB). In addition, a number of artificial constraints are imposed on aircrews by the ORI regulation:

> Each attack simulates the expenditure of one AIM-7 or AIM-9 or the expenditure of 25 percent of a fully loaded gun system. Except for low altitude attacks and reattacks (all altitudes), aircrews should expend the designated missile before gun attacks. . . . Aircrews may reattack IAW MCM 55-200, unless denied by the controlling agency. However, aircrews that reattack must provide the rationale for the reattack. Aircrews submit reattack rationale to the IG in writing (37:10-41 - 10-42).

Because the ORI evaluates an "intercept" scenario, with artificial weapons employment and structured tactics, units are encouraged to train for this mission. In fact, a "one hack and RTB" mode is attractive because it helps to generate the high sortie rates required by the ORI. Yet during the most realistic training scenarios (Flag exercises and local ACT/DACT), seldom do missions involve one intercept against a mildly-maneuvering target and then RTB--even during an area defense scenario. Fighters normally stay on station until out of fuel, out of weapons, or the vulnerability time is over. Moreover, the intercept is merely one phase in any combat mission. What follows the intercept is not solely a function of the mission type but also based on the type, number, and reaction of the target(s). Thus, one of the keys to realistic training and evaluation is a realistic threat. The tactics and weapons employment should be appropriate to the threat as well as the mission. Results (success or failure) should be

evaluated on the accomplishment of the task, irrespective of the requirement to reattack or the sequence of weapons employed (64:--; 65:--).

In summary, despite the great improvement in ORI realism and evaluation criteria, the artificialities of the Air Defense Alert mission create a significant influence on local training by encouraging a "one hack and RTB" mode that differs considerably from normal realistic training scenarios. In addition to evaluating employment that is contrary to that common in everyday training, the effect of these artificial constraints is an inordinate amount of training flown during sortie surges in which very little realistic ACBT training is accomplished (64:--; 65:--).

Non-Flying Evaluations

In addition to ORIs and checkrides, squadrons face a number of other evaluations oriented primarily at administrative effectiveness. These include Management Effectiveness Inspections (MEIs) and Stan Eval visits. The purpose here is not to analyze these in great detail but to briefly point out their effect on flying training.

MEIs and Stan Eval visits are designed to evaluate the effectiveness of a wide variety of squadron and wing programs that may or may not relate directly to flying training. MEIs give wings 45 days prior notice and Stan Eval visits 30 days (38:2-2). In an effort to prepare for these inspections, units expend a considerable amount of time and effort during this period to clean up program administration, paperwork, and prepare for testing. Much of this effort is performed after hours and on weekends since the normal training workload continues. The effect on flying training is a general de-emphasis on effective mission briefings and debriefings, less effort in producing quality scenarios, and less combat-related self-study. The evaluations assess principally what has been done to prepare for the inspection rather than normal daily activities (63:--; 64:--; 65:--).

Recommendations

In an effort to improve the accuracy of evaluations and minimize their negative impact on training programs, the following are recommended:

1. TACR 60-2 should establish a coordination process between squadrons and wing to ensure that training programs, performance standards, checkride scenarios, and evaluation criteria are consistent.
2. TACR 60-2 should include varying performance criteria consistent with TACM 51-50 GCC training levels. If a pilot is training to B-level, he should be evaluated against more difficult criteria than a pilot at A-level.
3. AFR 123-1 TAC Supplement 2 should be rewritten to eliminate the emphasis on "intercepts" so that Air Defense Alert more accurately reflects realistic expected wartime scenarios and to eliminate artificialities in weapons employment and tactics.
4. Non-flying inspections and visits should be de-emphasized to reduce their importance vis-a-vis flying training while still aiding units in their management effectiveness.

FLYING TIME MANAGEMENT

Thus far this chapter has examined three TAC publications that involve planning and evaluating training plans and the quality of training. In terms of the quantity of training, over the last six years the average utilization rates (sorties per aircraft per month) in TAC have increased approximately 60 percent (70:--). However, for a number of reasons proficiency may not have increased at the same rate. This section will examine a number of factors affecting both the quality and the quantity of flying training.

Quality

Increased utilization rates have obviously increased the total number of sorties flown, but this has not resulted in equivalent increases in the amount of quality training. Air-to-air training requires adequate airspace and adversary aircraft (similar or dissimilar) to provide a realistic training environment. Therefore, late takeoffs, bad weather, and single-ship missions detract from effective air-to-air training. This section will explain how a number of factors increase the pressure to meet sortie goals and, therefore, increase the frequency of missions when the quality of training is degraded. The following publications are referenced:

1. TAC Pamphlet (TACP) 66-32, "Ute Rate Programming & Information Guide"
2. TAC Regulation (TACR) 55-20, "Flying Hour Management"
3. TACR 66-5, "Combat Oriented Maintenance Organization"
4. TACR 60-5, "Aircraft Flying and Maintenance Plan Scheduling Effectiveness".

TACR 55-20 states, "flying hours are allocated quarterly to coincide with DOD fiscal budget and accounting requirements. . . . Deviations in excess of 2% of the quarterly allocations. . . must be explained and adjustments to follow on quarters necessary to bring the program back to the yearly goal must be addressed" (36:2). TACP 66-32 emphasizes the flexibility intended by allowing the unit to "vary its monthly programmed UTE [utilization] rate [sorties per month per aircraft possessed]. . . any way it wishes provided that the year-end UTE rate and allocated hours meet the TAC year-end assigned goals" (39:1-2). Yet despite this unit flexibility, there seems to be increasing pressure to meet monthly sortie totals with little willingness to reprogram into other months when unusual circumstances appreciably change actual attrition from planned. Thus, when short of the sortie line toward the end of the month, sorties are flown for marginal training value to help make the monthly goal. Typically, these include instrument sorties for which no TACM 51-50 requirement exists (experienced pilot, or inexperienced pilot who has already flown his two instrument sorties), single-ship handling missions, intercept sorties, and last-minute scrambles to put up unplanned weather-adds (63:--; 64:--; 65:--).

A factor adding to this tendency is the concept of the "Ute Down Day"--a reward for beating planned attrition (making the monthly sortie goal early) by standing down on the last day of the month. However, there is increased pressure toward the end of the month to fly sorties to meet the ute rate prior to that last day--as if planned as a no-fly day. Similarly, planned down days during the month further increase the end-of-the-month pressure for sorties. Assuming there is an average if 20 flying days per month, any day not flown effectively increases the ute rate by 5 percent (64:--; 65:--).

One way of lessening the daily schedule burden but still meet a high ute rate is the "sortie surge," commonly up to four days flying higher than normal sortie rates. Besides helping to meet a high ute rate, surges exercise the maintenance sortie-generating capability. From the author's point of view, however, the effect on operations is to diminish the training value of each sortie because of limited planning, shorter briefings, shorter debriefings (if accomplished at all), shorter sorties (to help turn the aircraft faster), and a lack of control over dissimilar adversaries.

Another factor that promotes the acceptance of lower-quality sorties is the deviation reporting system described in TACR 60-5 and TACR 66-5. Deviations are unplanned changes to the printed schedule that are tracked as an indication of management and scheduling effectiveness. TACR 66-5 states, "Operations and maintenance share responsibility for monitoring and controlling deviations from the published schedule" (32:3-1; 34:3-14). Based on this guidance, there is some amount of pressure to avoid taking "chargeable deviations." Thus, in order to avoid a ground abort, an aircraft may be flown up to two hours past scheduled takeoff time--a late takeoff but not a ground abort. Since sorties seldom last more than 1.3 hours, this results in at least one single-ship collateral sortie. TACR 60-5 states that the sortie need not be flown if operations considers that it will not be an effective mission (32:3-1). But, in the author's experience, this seldom occurs.

Quantity

While ute rates have increased considerably over the last few years, the average number of sorties per pilot has failed to approach the number that equates to GCC level C (stated as the TACM 51-50 goal) (40:3-2). In fact, to achieve that level, given the average number of pilots flying in the typical F-15 squadron (about 39), a ute rate of about 23 would be required (refer to Appendix A for the specific numbers used). Current ute rates are between 20.0 and 22.0 (26:--; 31:--; 44:--).

Furthermore, despite the statement in TACM 51-50 that "inexperienced primary aircrews will receive sortie allocation priority over experienced aircrews," in reality this is nearly impossible. Under current TAC guidance, there are very few missions that may be flown by inexperienced pilots (generally wingmen) without a flight lead or instructor (experienced pilots). Additionally, since inexperienced pilots generally have more restrictive weather minimums, they often get shorted in bad weather months. Therefore, it is unlikely that inexperienced pilots can obtain a greater number of sorties than experienced pilots.

Another reason why inexperienced pilots get shorted is that due to high personnel turnover rates (2.2 to 2.6 average years on station in TAC), upgrade training takes up a large percentage of the sorties (nearly 20 percent--see Appendix A) (70:--). Naturally, instructors (experienced pilots) end up flying more because of the upgrade load. In fact, instructor pilots typically fly about once a day (63:--; 64:--). Thus, because of the need for instructors and the requirement to have at least one flight lead per wingman (on the average), wingmen have little real priority on the schedule.

In summary, though TACM 51-50 states its goal as C-level, due to the high number of pilots flying in the squadrons, the instructor pilot requirements, and the lack of real priority for the inexperienced pilots, it is unlikely that the goal will be met. And, inexperienced pilots will commonly fly less than experienced pilots.

Recommendations

1. TAC should discourage strict monthly ute rate management in F-15 wings and encourage monthly reprogramming for unplanned attrition.

2. Squadrons should be encouraged to exercise the prerogative of not flying ineffective sorties to avoid deviations. This will require a de-emphasis on reporting procedures to remove the pressures to avoid deviations.

3. Squadrons should examine methods of scheduling to minimize the need for surge flying except when practicing for ORIs.

4. Squadrons should use planned down days infrequently because of the added pressure this creates on making the monthly contract.

5. TAC should study the number of attached wing and higher headquarters fliers in F-15 wings to determine the effect on average sorties per month for assigned primary pilots.

6. TAC and wings should examine upgrade programs to eliminate unneeded sorties and reduce the number of sorties requiring an instructor pilot.

ADDITIONAL PROBLEM AREAS

Based on the research for this project, the author is aware of a number of other potential problems with air-to-air continuation training in TAC. Due to the scope of this project, they are only mentioned here, but each deserves further study. These include:

1. Personnel turmoil (short-notice temporary duties and reassignments, low time on station, low experience levels).

2. Long crew duty days and non-flying training and tasks (the subject of an ongoing TAC inspection).

3. Lack of support for squadron-level training programs by higher headquarters (wing, numbered air force, major command).

4. Lack of Flag exercise and DACT opportunities.

5. Airspace and range problems.

6. Lack of sufficient training assets (especially ECM).

7. Training rules and restrictions.

8. Scenario artificialities such as real-time kill removal.

9. Gun camera and video tape player system deficiencies.

10. Multiple mission tasking (air-to-air and air-to-ground) and the impact on air-to-air training.

11. Deficiencies in computerized tracking systems (AFORMS and TAFTRAMS).

SUMMARY

The impressive gains over the last decade in the quality and quantity of air-to-air training are offset by a number of factors that diminish the effectiveness of squadron-planned training. The principal training manual, TACM 51-50, has become so long and complex that squadrons have lost some control over their programs. Squadrons find it necessary to spend increasing time and effort tracking the multitude of events, sorties, and currencies which drive the scheduling process at the expense of realistic squadron-planned training. Next, though training programs are sensitive to flying evaluations (checkrides and ORIs), there is a lack of coordination between realistic

day-to-day training and evaluation leading to significant training artificialities. Finally, pressure to make monthly sortie contracts and avoid deviations further erodes the quality of the training. Hopefully, close examination of some of these problems will increase squadron autonomy and flexibility in planning the realistic training programs called for in both TACM 51-50 and TACR 55-79.

Having discussed the difficulties facing squadrons, this project now focuses on factors squadrons can control: planning and executing training programs. Acknowledging how many constraints exist, the author believes that it is still possible for unit level programs to succeed. While certainly not an easy task, planning and executing training programs is, nevertheless, a necessity.

Chapter Four

SQUADRON-LEVEL TRAINING PLANS

Clearly, there are considerable difficulties facing squadrons in their efforts to plan and execute training programs. In fact, because it becomes "too hard to do," some squadrons make little effort to plan training programs. Their programs become the outcome of the daily schedule (rather than the other way around). The primary objective becomes accomplishing the published training requirements. The results of allowing the training program to become a fall-out of the schedule are inefficiency (you simply cannot accomplish as much) and unequal distribution of training (the program lacks control over the balance of mission types and scenarios). Because of inefficiency, some desirable training is minimally flown or skipped--especially basic missions such as Advanced Handling Characteristics (AHC) and Basic Fighter Maneuvers (BFM).

For squadrons that regularly plan training, a number of shortcomings diminish the benefits. For example, squadrons infrequently state the overall objectives, or performance standards, of the program. Without such a yardstick, progress is difficult to measure. Secondly, squadrons do not plan their activities early enough to use as an input to wing staff agencies, and last-minute inputs from wing disrupt the plan. Finally, though measurable learning objectives are carefully briefed and debriefed for individual missions, there is rarely any follow-up when the mission objectives are not achieved--the training and scheduling system does not adjust for failure to progress.

In light of the consequences of failing to carefully plan continuation training, this chapter suggests some guidelines to help squadrons avoid some of these problems.

GENERAL CONSIDERATIONS

TACM 51-50 requires training programs to be "designed to achieve the highest degree of combat capability within available resources. . . . All training should be scheduled to maintain a steady regular flow, and will be tailored to individual aircrew proficiency and experience" (40:1-2).

Combat capability can be defined as the ability to successfully perform the wartime mission--"to fight and win" (14:9). Because of the complexity of modern aerial combat, much of this capability is based on split-second judgment, habit patterns, and instinctive reactions learned during training (10:5). Many have expressed it this way: "You fight like you train." It follows, then, that training should, to the greatest extent possible within peacetime constraints, provide an environment that encourages the innovation of tactics, teaches tactical skills, and develops the instincts appropriate to combat. Moreover, the capability must be measured against definitive standards of performance. The essence of this evaluation is to determine the quality of the product,

not the quantity of the training (52:54). For this reason, squadrons must plan training programs to supplement the quantitative guidance in TACM 51-50.

The type of program depends on the needs of the squadron. Operational air-to-air squadrons need a program somewhere between a formal syllabus (Replacement Training Unit) and a set of general requirements (TACM 51-50). In any case, to succeed, training programs need to be

1. Flexible--not merely to account for last-minute inputs but, more importantly, to adapt to individual proficiency and progress (7:22; 56:35).
2. Progressive--work from the basic to the complex (33:10-1 - 10-2).
3. Regressive--a phase every training cycle for the basics (advanced handling, BFM, and ACM) (57:69).
4. Attainable--realistically account for the continuation training sorties available, dissimilar adversaries, and other training assets.
5. Safe--or it will not sell.
6. Measurable--squadrons must be able to measure their own progress through the program (12:21; 57:66).
7. Balanced between repetition and depth--repetition provides proficiency, but depth in training means an exposure to a wide variety of missions and progress from basic to complex (56:39).
8. Realistic--only by providing a realistic combat environment and threat can aircrews be expected to develop realistic tactics and sound judgment (7:21; 14:9; 52:30).

PLANNING CONTINUATION TRAINING

When

For any program to succeed, a planning session must occur early enough to be an input to wing activities and to the schedule, and to obtain training assets (adversaries, tankers, ECM assets); but, late enough to include accurate constraints from outside agencies (wing-planned exercises, the dart schedule). Squadrons should conduct a planning session no later than two months prior to each half (November and May).

Who

TAC Regulation 55-79 states, "The air-to-air program will be designed and administered by unit weapons officers and instructors" (33:10-5). Therefore, the squadron weapons officer should plan and chair this planning meeting. Attendance should include any or all of the squadron top three (certainly the Operations Officer), training officer, scheduler, flight commanders, and instructor pilots. The weapons officer should prepare a proposed training plan prior to this meeting which contains a tentative schedule of the half's activities. The wing and squadron schedulers and training officers can be of immense help with this.

Agenda

The planning meeting should accomplish the following (41:1-1 - 1-2):

1. Identify the squadron's combat or contingency tasking. This may be an obvious step, but important. The most likely wartime missions are listed for developing tactics scenarios later.

2. List the major constraints affecting the training cycle. First, lay out a tentative schedule of major events for the half over which the squadron has no control (see Table 6). At this meeting, it may be beneficial to lay these out for the next 12 months, and update every 6 months. In this way, the training plan smoothly transitions from one half to the next. For example, while planning the first half, it would be helpful to account for a Red Flag in July. Next, account for higher headquarters requirements (TACM 51-50). Finally, consider any other major impacts on the plan.

3. Decide on areas of emphasis. Discuss weak areas from past training cycles and identify particular areas deserving emphasis: for example, BFM, radar sorting, or weapons employment. Discuss preparation programs for major training events (Flag exercises, deployments). Discuss the scenarios to correct past weaknesses. For example, the squadron may need to work on force protection and can afford to decrease emphasis on point defense based on recent Flag exercise experience. Plan to concentrate on each mission for a week or so and obtain adversary support or a deployment to meet the needs of the scenario.

4. Construct Modules or Phases. Divide the half into several 4- to 6-week "modules" or phases based on the major training events. Each module reflects an area of emphasis or a training phase such as "Back to Basics" (AHC, BFM, ACM), ECCM training, 2-ship employment, or 4-ship employment. To the maximum extent, these phases should progress logically--from basic to complex. The basics need not start in the first month of the half. In fact, seldom will major training events allow a "proficiency cycle" to begin at the start of the training cycle. Nevertheless, certain phases should be repeated every six months, especially the basics (15:21; 33:10-2).

5. Set objectives. Objectives should state a level of capability or performance standard for the entire semi-annual cycle and for each phase. More on this later.

6. Integrate the training resources. Mesh academics, ground training, and simulator scenarios into the plan to support the flying activities. For example, prior to flying against ECM-equipped adversaries, plan to teach ECCM academics and set up an ECCM simulator scenario.

7. Assign project officers. Identify who is responsible for what parts of the training plan. See Table 7 for examples. Set a suspense for inputs with sufficient time to assimilate, coordinate, and publish a final plan prior to scheduling deadlines.

- Local Exercises
  - Practice Operational Readiness Inspections (ORIs)
  - Sortie Surges
- Deployments
  - Weapons System Evaluation Program (WSEP)
  - Checkered Flag
  - Small deployments
- Flag Exercises
  - Red Flag
  - Maple Flag
- Composite Force Training (CFT) Exercises
  - Quick Thrust
  - Quick Force
- Aggressor Visits
- Night Flying
- Darts
- ECM Training
- Tankers
- Evaluations
  - Stan Eval Visits
  - ORIs
  - Management Effectiveness Inspections (MEIs)
- Significant Training Loads
  - Mission Qualification Training (MQT)
  - Surface Attack
- What Ifs
  - ORIs
  - Real-world Contingency Tasking
  - Maintenance Inputs (groundings, TCTOs)
  - Down Days (changes of command)

Table 6. Major Training Events

Training:

1. Ensure AFORMS/TAFTRAMS support for tracking training accomplishments.
2. Arrange non-flying activities.
3. Monitor training accomplishments.

Stan Eval:

1. Coordinate with wing Stan Eval on checkride scenarios.
2. Prepare local area briefings for visiting adversaries.

Weapons and Tactics:

1. Conduct weapons academics.
2. Construct training scenarios.
3. Obtain dissimilar adversaries.
4. Distribute copies of training plan to wing agencies. Face-to-face brief when applicable.

Scheduling:

1. Obtain appropriate airspace.
2. Schedule appropriate flight sizes and configurations.
3. Coordinate with maintenance.

A-Flight Commander:

1. Coordinate with the operations officer to provide a project officer for the Aggressor visit.
2. Monitor flight progress and coordinate with scheduling for special requests.

B-Flight Commander:

1. Coordinate with the operations officer to provide a project officer for Red Flag.
2. Monitor flight progress and coordinate with scheduling for special requests.

Table 7. Examples of Project Officer/Functional Area Responsibilities

Coordination

After establishing a tentative training plan which satisfies the squadron commander, the weapons or training officer should distribute a copy to every agency in the wing having the potential to impact the program: the wing DO, scheduler, weapons officer, training officer, inspection branch, Stan Eval, maintenance, and GCI. Whenever possible, brief these agencies face-to-face, especially the DO, to make them aware of the impact of changes on the squadron's plans. Also, frequent (daily) coordination with the maintenance unit throughout the planning phase and during the training cycle is essential to ensure what is planned is capable of being supported. The coordination step is the most crucial since the success of the plan hinges on minimizing the turmoil caused by last minute inputs and changes (66:--; 68:--).

Follow-Up

Prior to the publication of each monthly schedule, the weapons officer, scheduler, training officer, and operations officer should meet to update and modify the next month's plan. A smaller monthly training plan, with week-by-week and day-to-day activities should be published and distributed. This plan should include flying scenarios, major events, academics, and other ground training. Publication and distribution will be just as for the six-month plan. Most importantly, schedulers should use this as a guide for flight sizes, areas, configurations, scenarios, academics, and ground training for each week's schedule.

AIR-TO-AIR TRAINING CONCEPTS

The following provides more specific suggestions about what should go into a training plan.

Skills

The purpose of a training plan is to attain and maintain combat capability. But combat capability is really the ability to perform a variety of skills (simple and complex, basic and tactical). Therefore, a training program must teach or refresh these skills so each pilot can pass an evaluation of his ability to perform a combat mission. Table 8 breaks down skills according to the phases of a typical combat mission. Table 9 relates mission types to skills. Some training missions (BFM, ACM, Intercepts) concentrate on portions of the typical combat mission while others (ACT, DACT, CFT) simulate the whole mission (33:10-1; 52:38; 61:13).

To ensure that every pilot accomplishes the required events (and therefore develops the skills), the training plan should establish specified numbers of each mission type (see "Training Goals" later in this chapter). Without these goals, flights frequently need to take time out of a tactical scenario to perform a training event for someone who needs a square because he was never scheduled for a particular mission.

COMBAT MISSION PHASES	SKILLS	
EVENTS/PHASES	BASIC	TACTICAL
Planning	Mission plan Brief	
Scramble		
Ground Ops	Scramble operations	
Takeoff		
Cruise	Transition skills	
Tanker Rendezvous		
Refueling	Air-to-air refueling	
Depart Tanker		
Cruise		
Arrive at CAP/Holding/ Rendezvous Point		
CAP/Hold		Tactical formation Radar employment: Search Sorting

Table 8. Mission Phases and Skills

EVENTS/PHASES	BASIC	TACTICAL
Commit/Push		
Ingress Intercept	Low-altitude skills Flying Formation Navigation	
		Tactical intercepts Aircraft ID All-aspect missile def Visual lookout
Merge		
Engaged	Handling Characteristics	
		BFM ACM Weapons employment Single-ship survival Low-altitude combat
Separate		
Egress	Low-altitude skills	
		Combat separations
Arrive at CAP/Tanker		
Return to Base		
Cruise Recovery	Transition skills	
Land		
Post-flight ground ops		
Combat Turn		

Table 8. Mission Phases and Skills (Continued)

Collateral Missions
- Mission planning and briefing
- Transition skills such as takeoff, landing, instruments, navigation, close and route formation

Advanced Handling Characteristics (AHC)
- All skills above plus:
- Single-ship aircraft handling

Basic Fighter Maneuvers (BFM)
- All skills above plus:
- 1V1 visual maneuvering: Offensive, Defensive, Neutral
- All-aspect missile defense
- Weapons employment and switchology
- Single-ship survival
- Combat separations

Air Combat Maneuvering (ACM)
- All skills above plus:
- 2-ship visual maneuvering
- Tactical formation
- Visual lookout
- Short-range commits
- Radio communication

Day Intercepts
- Radar employment: Search and sorting
- Tactical intercepts
- Aircraft Identification
- Tactical formation
- Weapons employment

Low-Altitude Air-to-Air Training (LOWAT)
- Low-altitude flying, formation, navigation
- Low-altitude tactical intercepts

Dart/Live Missile Firing
- Tactical formation
- Tactical intercepts
- Weapons employment

ACT/DACT/CFT
- All skills above during a combat scenario

Night Intercepts
- All skills above except visual maneuvering and low-altitude

Miscellaneous Skills
- Air-to-air refueling and scramble practice can be accomplished on any sortie.

Table 9. Skills by Mission Type

Training Resources

Thus far, the discussion has centered on flying training. However, some skills cannot always be practiced during peacetime: tank jettison, communications jamming (during ACBT missions), aircraft emergencies, tactical use of clouds, electronic countermeasures (ECM), and large multi-bogey scenarios. For these reasons, it is imperative for the training plan to include other training resources to "fill the gaps." Table 10 is a list of training media to supplement the flying missions already discussed.

Academics also provide a method of preparing the squadron for upcoming training events or phases (for example, ECCM academics prior to an ECM exercise, low-altitude academics prior to low-altitude intercept module). Table 11 provides a list of academic courses.

Cockpit Procedural Trainer (CPT)
Checkered Flag Verification
Simulator
Academics
Self-Study
Tactics Reviews
Tactical Expert Program
Visiting Expert Briefings

Table 10. Non-Flying Training Resources (57:63)

Systems Academics:	
	Radar
	AIM-7
	AIM-9
	Gun
	AAI/Mode 4
	Communications-jamming/Have Quick Radio
	TEWS
	Degraded Systems
	ECCM
Flying Phases:	
	BFM
	ACM
	Tactical Intercepts
	Low Altitude Employment
	2-Ship Employment
	4-Ship Employment
	All-Aspect Missile Defense
	Tactical Lessons Learned
Miscellaneous:	
	Threat Aircraft, Weapons, Tactics
	GCI, Command and Control
	Plans Briefing
	Intelligence Briefings
	Friendly EC Assets
	Threat EC Assets

Table 11. Academic Subjects

The "Building Block Approach"

Referring back to Table 9, each air-to-air training mission builds upon the skills developed in previous missions. For example, ACM builds on BFM skills to develop 2-ship maneuvering proficiency. Therefore, each training module should be constructed so that missions are flown sequentially to enhance this "building block" learning. This also allows an individual to progress from easy to difficult, basic to complex, according to his experience and proficiency, as required by TACR 55-79 (18:10; 33:10-1; 52:ix). Each mission contributes to the module objectives. Each builds on the lessons of the preceding mission. Table 12 shows an example of mission progress within the program and within each module.

Basics Module	Tactics Module
AHC	Tactical Intercepts
BFM	ACT: Similar 2V2
Offensive	DACT
Defensive	2V2
Neutral	2V4
All-aspect missile defense	2VX
Dissimilar BFM	4V4
ACM	4V6
Initial Moves	4VX
Short-range Commits	Aggressor Visit
Visual Point CAP	Composite Force Training Exer
Dissimilar ACM	
Dart	

Special Missions Module	Deployment/Exer Module
ECCM	Specialized plan/missions for
Comm-jamming	a major training exercise
Night Flying	preparation:
LOWAT	Red Flag/Maple Flag
High-Fast Flier	WSEP
Sortie Surge	Checkered Flag
	Composite Force Training

Table 12. Missions and Phases: "The Building Block Approach"

Likewise, phases, whenever practical, should be progressive: basics followed by tactics followed by deployment modules. There are certainly occasions when the major events in the half will not allow this (33:10-8; 52:31).

Each mission, especially basic missions, should be flown using progressively more difficult set-ups. A good example is the use of the progressive perch system in offensive BFM to give the attacker less offensive advantage as he demonstrates proficiency. Progress is based on the achievement of specific, measurable standards of performance in each engagement. The instructor or flight lead controls the progress toward more difficult set-ups.

The keys to maximizing the benefit of this training concept are sequential, progressive scheduling and the establishment of challenging, measurable performance standards. Failure to meet the standards should result in a repeat of the training, whether a single engagement or a whole mission (52:35). Progress should be based on demonstrated performance (33:10-8).

Realizing that formal syllabi, grade books, and tracking methods would be an unwelcome workload, the way to make such a system work is to emphasize the role of the flight commander in monitoring the proficiency and progress of his pilots. A flight commander cannot fly every mission with every one of his pilots. Therefore, he must rely on informal feedback from squadron instructor pilots and flight leaders. Also, he must be able to make inputs to the schedule so that his pilots fly appropriate missions (18:10-11).

The squadron scheduling system must be responsive to the training plan sequence and to the individual needs expressed through flight commander inputs (7:22). The author recommends daily schedules be annotated with the specific mission (using a number system for scenarios: BFM-1, BFM-2, . . . , DACT-4; or the type mission: Offensive BFM, Defensive BFM, . . .).

Objectives

The key to the building block approach is the use of "measurable objectives": you cannot evaluate capability without a measuring stick or performance standard. Objectives allow progress at the correct rate--fast enough to present a challenge, but not so fast as to skip skills along the way. Moreover, objectives focus everyone's attention on what is important and place emphasis where it is needed. Most pilots will prepare to pass their evaluation. Therefore, it is important to use evaluations and standards that encourage successful tactical employment (12:22). There are a number of terms that convey these concepts. These definitions are provided to simplify the discussion (examples in Table 13):

"Training Goals" are quantitative guidelines for events and sorties such as those found in TACM 51-50. While important to ensure a reasonable allocation of sorties, quantitative guidelines do not measure capability, only accomplishment. For this reason, units need to establish standards of performance against which to measure capability.

Training Goals: TACM 51-50 required events and sorties

Performance Standards:

Mission Element

"Sort at least 3 of 4 adversaries."

"From a 6000' offensive perch, obtain weapons parameters and launch a valid weapon."

Mission

"Maintain a point CAP for 20 minutes."

"Allow no threat bombers to attack the target."

"Lose no friendly aircraft."

Phase/Module

"Meet the increasingly more difficult objectives on each of the training missions of the phase in preparation for Red Flag."

Six-Month Training Plan

"Be consistently able to perform in a 2-ship or 4-ship, during any one of four scenarios (Force Protection, Point CAP, Area Defense, and Sweep), under degraded circumstances (outnumbered, restricted ROE, limited GCI, all-aspect threat).

Learning Objectives: Radar sorting, tactical formation, visual lookout

Tactical Objectives: "Protect 8 F-4s attacking target #63 at 1630Z."

Table 13. Examples of "Objectives"

"Standards of Performance" will be used here for the concept often called "measurable objectives." Performance standards merely describe the level of performance expected for any training event, from individual mission elements to the entire training plan. Success is measured against these standards. Failure to achieve them can usually be traced to a bad plan or a breakdown in execution. Identification of these "lessons learned" should result in increased emphasis in later missions and training cycles. Failure to meet the standards should also result in a repeat of that sortie. There is little logic in progressing to a more difficult scenario.

"Learning Objectives" are simply areas of emphasis during a mission based on the individual proficiencies of the participants, the phase of training, and past weak areas. Performance standards provide the method of demonstrating proficiency in these areas.

"Tactical Objectives" are mission-oriented tasks such as defending an area against enemy aircraft for a specified time. These relate to tactical missions scenarios.

In addition to planning specific mission scenarios, the training program should address each type of objective. Flight commanders, instructors, and flight leads should modify the learning objectives to meet more specific day-to-day needs.

To be effective, objectives need to be (1) graduated--increasingly more difficult for each set-up or mission, (2) tailored to the individual based on experience and proficiency, and (3) measurable--otherwise, there is no way to assess performance and progress. "Good radar work" should be expressed as "Sort at least 3 of 4 bandits" (11:11).

Finally, if the wing has not specified the level of performance expected during checkrides, it would be worthwhile to coordinate with Stan Eval on squadron performance standards to ensure that evaluations are consistent with training plan objectives.

Back to Basics

Why the Basics? TACR 55-79 states, "To maintain a high level of . . . aircrew proficiency in the basics of ACBT, a periodic return to practice of basic skills in AHC, BFM, and ACM training is encouraged and expected" (33:10-2). There are a number of reasons for a basics module in every semi-annual training plan (52:44).

First, pilots must be adequately trained in the full spectrum of air-to-air combat from Beyond Visual Range (BVR) engagements to close-in maneuvering (33:10-1). Basic missions develop proficiency in the maneuvering phase. Second, even prior to the maneuvering phase, the decision to turn to engage a threat is made based on the judgment learned in BFM and ACM: How long will it take to kill this bandit and how much time is available? Is the bandit a threat to me? These questions become instinctive reactions through an extensive BFM program. The ability to execute initial moves and short-range commit tactics are developed in ACM. Minimum-time turns and combat separation techniques are perfected in AHC.

The growing complexity of modern aerial combat demands a "second-nature" ability in the basic skills. Multiple threats, communications jamming, and low-altitude combat distract the pilot during an engagement. As proficiency in the basics increases, more

attention can be paid to other things: developing situation awareness, looking for other threats, protecting your wingman, fuel state, and so on (15:19; 17:26).

A maneuvering engagement is likely to occur during any combat scenario. Turning cannot be avoided simply through tactical planning. There are scenarios which demand a turn to engage a threat (point CAP defense of a valuable resource) and circumstances which require a turning engagement to survive (defensive reaction). The ability to attain quick victories and survive in turning fights is, therefore, a tactical necessity (15:19).

"BFM is a perishable skill" (17:27). Any demanding physical or mental activity requires periodic recurrency to maintain proficiency. Since tactics missions (ACT, DACT) rarely concentrate solely on the maneuvering phase, a dedicated "Back-to-Basics" phase emphasizing AHC, BFM, and ACM is necessary (17:21).

Finally, without a strong foundation in the basics, the whole point of complex tactics missions may be lost. There is an obvious need to train to the level of Red Flag and multi-bogey DACT since they represent our best simulation of combat (7:22). But without a solid proficiency at basic skills, "tactics missions may serve only to develop invalid employment options" (15:19). BFM and ACM errors may lead to the conclusion that a tactic was bad when in fact it was poor execution, not poor planning. Or, poor BFM by the adversaries may "validate" a bad tactic (15:19).

<u>The Back-to-Basics Program.</u> The Fighter Weapons School has published a number of texts and articles describing how to run a BFM/ACM program. A few points to consider are provided here:

First, BFM and ACM emphasize the visual portion of a combat mission. While most engagements begin with an intercept by one side on another, the outcome of any intercept is either an offensive advantage, defensive disadvantage, or a neutral pass. If a weakness in tactical intercepts or radar work comes to light because of a trend of less-than-offensive merge entries, then intercept missions should be scheduled to meet this need. However, if the mission is BFM, flying an intercept to an engagement uses fuel which could be used for more engagements. Therefore, the author does <u>not</u> recommend beginning BFM or ACM from a long-range tactical intercept.

Secondly, BFM in particular should emphasize the maneuvers to counter or defeat a threat. BFM should not be used to demonstrate that a superior jet (a power advantage) can defeat an inferior jet. BFM is man-on-man. Given a positional advantage, the attacker should be able to kill the defender or at least not lose the advantage. With aircraft limitations, the results cannot positively be ascribed to BFM as opposed to aircraft differences. With carefully structured objectives and strong instructor pilot or flight lead control, the flight can progress to more difficult set-ups as proficiency increases. Dissimilar BFM can be used to develop an appreciation for relative strengths and weaknesses between aircraft types.

BFM and ACM should not concentrate solely on the gun but should allow a kill for an appropriate combination of weapons (in accordance with standard unit kill criteria). Restricting ordnance (just as restricting power) can develop bad habit patterns.

Each BFM mission should be confined to one role for each participant (all offensive or defensive or neutral) to concentrate on one aspect of the problem and to allow progress to more difficult set-ups. For the same reasons, ACM (3-ship) missions should preserve the element and the single in their roles for the entire mission (15:20). The appendix contains examples of AHC, BFM, and ACM scenarios.

The importance of clearly defined and measurable objectives in this phase cannot be over-emphasized. Objectives serve to measure proficiency, allow progress based on demonstrated performance, and encourage termination of engagements when learning outcomes occur (15:20; 52:41). Timely "Knock-it-offs" allow more engagements, reinforce lessons learned, and minimize the risk of exceeding prudent peacetime safety constraints.

Realistic Training and Scenario Development

In air-to-air training "you fight like you train" and, therefore, "you should train the way you intend to fight" (12:21). Thus, peacetime tactics training should be as realistic as possible within peacetime constraints (14:9). Probably the most realistic peacetime training is provided during Aggressor visits, Flag exercises, and Composite Force Training exercises. However, as these represent only a small portion of tactics training, everyday ACT and DACT provide the bulk of realistic training. It is during the day-to-day training that tactics innovation occurs, tactical judgment and decision-making are developed, and to some extent combat capability evaluated. A productive tactics phase allows the major training events to be used as the ultimate evaluation of overall squadron combat capability and to test the validity of new tactics (5:10; 52:30).

DACT generally represents the best source of day-to-day realistic training because it provides an opportunity for multi-bogey (outnumbered) scenarios, simulation of threat aircraft and ordnance, and analysis of relative strengths and weaknesses among different aircraft (33:10-8). Flying against superior numbers as often as possible reflects the expected threat environment in nearly every theater (4.7 to 7.4:1 in Europe, for example) (57:55). Also, it is unrealistic to provide two adversaries and expect pilots to react as if there were an unknown number of threats. Realism can be enhanced by keeping the actual number unknown during DACT. Sound habit patterns (belly checks and avoiding the engagement of non-threats, for example) are developed in a realistic environment which provides incentives for smart tactics and penalizes mistakes.

There are several keys to developing realistic scenarios. First, each squadron should have a clear understanding of its possible wartime missions. Table 14 provides a list of air-to-air roles. Secondly, obtain dissimilar "threats" which meet the scenario needs of the training plan. Third, incorporate combat planning factors into the scenario. Table 15 is a list of scenario parameters to consider. Intelligence and Plans can also contribute to realism. Scenarios should include realistic kill criteria and kill removal to provide rewards for good execution and penalties for mistakes. Finally, evaluation should be based on the performance standards established for each mission (12:--).

Combat Air Patrol (CAP)

Point CAP
Base Defense CAP
Lane CAP
Area Defense CAP
Roving CAP
Barrier CAP
Search and Rescue (SAR) CAP

Fighter Sweep

Force Protection/Escort for:

Fighters
Bombers
Reconnaissance
Airlift
AWACS
Tanker
Close Air Support
Slow-movers

Special Missions

High-Fast Target Defense
Air Defense Alert
Jammer Attack
Cruise Missile Defense
Slow-mover/Helicopter Attack

Table 14. Air-to-Air Missions (57:61-62)

SITUATION
State/Stage of Conflict
FEBA/FLOT
Theater

OBJECTIVES (for both sides)
Tactical Objectives
Performance Standards

FRIENDLY AND THREAT PARAMETERS
Roles
CAP/Starting Points
Simulated Ground Threats
GCI/AWACS
Number/Type of Aircraft
Ordnance Loads
Rules of Engagement (VID or BVR criteria)
Minimum Risk Passage Procedures
Avionics Limitations
IFF Squawks
Tankers
ECM Support

SCENARIO PARAMETERS
Blocks
Weapons Parameters
Kill Criteria
Kill Removal
Safe Areas
Frequencies
Knock-it-off Criteria

Table 15. Realistic Scenario Elements

TRAINING GOALS

Specific sortie mixes by aircraft, experience level, and GCC-level are provided by TAC message each half. Mission categories include Air Combat Training (ACBT), Day Intercept, Night Intercept, Dart, and Low Altitude Air-to-Air Training. As a supplement to and based on the minimums in TACM 51-50, Table 16 is an example of a more specific breakdown of sorties in a semi-annual training plan. These sortie goals ensure a variety of training, a thorough exposure to both basic and advanced scenarios, and a basis for progressive training. Since sorties are tracked (or can be tracked) by current computer methods, no additional workload should result. However, a failure to track sorties at this level of detail commonly results in some pilots flying a disproportionate share of sorties in one category to the exclusion of others. Planned module training helps attain these goals by concentrating the entire squadron's effort on a few mission types.

GCC Mission Type	Sorties per half per pilot
Advanced Handling Characteristics (AHC)	1
Air Combat Training (ACBT)	50
Basic Fighter Maneuvers (BFM)	.5
Air Combat Maneuvering (ACM)	.5
Air Combat Tactics (ACT): 2V2	15
Dissimilar ACT (DACT): 2VX	.9
DACT: 4VX	10
Composite Force Training (CFT)/Flag Exercise: 2VX	.3
CFT/Flag: 4VX	.3
Day Intercept/Low Intercept	.5
Dart/Weapons Employment	.2
Night Intercept	.3
TOTAL GCC SORTIES	61

Assumptions:
(See also Appendix A)
20 UTE rate
39 pilots
No air-to-ground commitment

Table 16. Sortie Goals

Collateral sorties include all instrument, chased, non-effective, deployment, and cross-country sorties.

Based on TACR 55-79, the "TAC goal is for 50% of ACBT training to be met using dissimilar assets" (33:10-2). Including Composite Force Training (CFT) exercises, this plan calls for 25 dissimilar ACBT and 25 BFM/ACM/ACT missions.

Day intercept and low-altitude air-to-air training requirements from TAC message guidelines are combined. The author recommends that all planned day intercept missions be flown at low altitude. Medium and high altitude intercept training requirements can be accomplished during ACT and DACT.

The 2-ship and 4-ship mix during tactics sorties (ACT, DACT, CFT) reflects a 2:1 ratio. The actual ratio should be tailored to the squadron's expected tasking and the availability of adversaries.

Table 17 provides a further breakdown of Air Combat Training into mission types. Scenarios, of course, should reflect a best-guess of squadron wartime tasking and needs.

BFM	.5
Offensive	.2
Defensive	.2
Neutral	.1
ACM	.5
Front quarter short commit	.1
Rear quarter defensive	.2
All-aspect threat, BVR set-up, visual CAP	.2
ACT/DACT	34
Sweep	.5
Point Defense	11
Area Defense	11
Force Protection	.7
CFT/Flag Exercises--IAW exercise tasking	

Table 17. Scenario Breakdown

PUTTING IT ALL TOGETHER

After all of the planning, the product should be a week-by-week program of flying and ground training activities. Table 18 depicts an example of such a plan based on the actual training events of an operational TAC F-15 squadron (43:--). Another useful format is the TAC Form 339, "Daily/Monthly Schedule," for each month in the cycle and include daily and weekly training events and scenarios. An example of this lay-out can be found in Appendix E.

The length of time in each phase is based on the training goals from Table 16 and the average number of continuation training (non-upgrade) GCC (effective tactical) sorties available per week. Appendix A illustrates the numbers used to construct this example plan (about 16 GCC continuation sorties per flying day). Therefore, for each pilot to receive 5 effective BFM sorties during the basic module takes about 11 flying days (considering some pilots will be involved in on-going upgrade training).

Within each module, the scenarios should be made increasingly more difficult by adding more threats, increasing scenario complexity (with ECM, restrictive ROE, ordnance limitations) and by using progressively more challenging performance standards.

SQUADRON-LEVEL EVALUATION

If the ultimate goal of a training program is combat capability, then the evaluation process must test this capability (52:88). The most obvious ways of measuring combat capability are Stan Eval checkrides, Operational Readiness Inspections (ORIs), and TACM 51-50 event accomplishment. But, despite the extensive effort in tracking TACM 51-50 events and sorties, the quantity of training accomplished is not necessarily a viable means of evaluating combat capability (52:28). Training events prepare each pilot for a level of combat capability. Evaluations measure the level of capability actually attained. We want to know "how well," not "how many" (52:54). There are a number of methods squadrons can use to measure performance (see Table 19).

"Evaluation criteria are a significant influence on the conduct of peacetime training" (52:88). The threat of checkrides and ORIs will certainly drive a training program (52:80). Therefore, it is imperative that squadrons work closely with wing Stan Eval to ensure that checkride scenarios are consistent with the squadron training program. We will continue to train for the test, so why not have a test which suits the squadron and wing needs (12:22).

In addition to the evaluation methods suggested in Table 19, the performance standards for each mission, phase, and for the entire program should be used to measure progress and results. If the objectives are realistic and the squadron emphasizes them, training will focus on achieving the standards (52:29). The key is how the squadron responds to a failure to meet performance standards. If a flight debriefing reveals a weak area because of a failure to meet a standard, a feedback process should ensure that follow-on training corrects the deficiency. If a trend develops, the next training cycle should emphasize the weak area. To make this happen, instructor pilots and flight leads need to pass on feedback to flight commanders about the performance of pilots with whom they fly and flight commanders need an active input to the schedule. Realistic and

Wk	Major Tng Event	Module	Missions	Academics
1		Red Flag Prep	Low Intercepts	Low-alt. Employment
2			2VX ACT/DACT	Force Protection
3			4VX DACT	CAP Employment
4	Red Flag		(Force Protection)	
5			(Area Defense/CAP)	
6	Night Flying		Night Scenario	Night Employment
	Darts		Dart	Gun Academics
7	Aggressor Visit		4VX DACT	4-ship Employment
8			(Sweep)	Aggressor Academics
9		Misc Scenarios	2VX ACT/DACT	2-ship Employment
10	Sortie Surge		2VX ACT/DACT	
			Low Intercepts	
11			2VX ACT/DACT	AIM-7 Academics
12			4VX DACT	All-aspect Msl Def
13	Night Flying		Night Scenario	
	Darts		Dart	
14		Back-to-Basics	AHC	BFM Academics
15			BFM	AIM 9 Academics
16				ADM Academics
17			ACM	Radar Academics
18				ECCM Academics
19		ECCM Phase	2VX ACT/DACT with ECM	
				TEWS Academics
20	Sortie Surge		2VX ACT/DACT	
			Low Intercepts	
21		Deployment Prep	2VX ACT/DACT	Degraded Systems Deployment Academics
22			4VX DACT	Comm-jam/Have Quick
23	Checkered Flag Deployment		2VX ACT/DACT	
24			and	
25			Low Intercepts	
26				

Table 18. Training Plan Example: Phases and Missions

Flying Performance
Aggressor Visits (flights, debriefs, out-briefs)
Fighter Weapons School IP visits (with Aggressors)
Flag Exercises
Composite Force Training Exercises
DACT
Local Exercises
Dart
Weapons System Evaluation Program (WSEP)
Electronic Warfare Evaluation Program (EWEP)
Air Combat Maneuvering Range (ACMR)
Stan Eval Checkrides
Squadron Top Gun Competition
Imagery Review Program (gun camera/VTR)
Tactics Mission Point Systems
Simulator Missions
Supervisor Flights

Reports and Analyses
Monthly/Quarterly Weapons Employment Analyses
Combat Capability Assessment Questionnaires
LIMFAC Letters
Maintenance/Equipment Tracking Programs

Testing
Stan Eval Tests
Squadron/Wing Weapons and Tactics Tests
Intelligence Tests
Visual Recognition Tests

Presentations
Checkered Flag Verifications
No-notice Air Tacking Order (ATO) Briefings
Tactics Reviews
"How-Goes-It" Lessons Learned Meetings

Table 19. Squadron-Level Evaluation Methods

progressive objectives, thorough debriefings, and flight commander influence in the scheduling process are essential.

Finally, squadron weapons employment programs and "Top Gun" competitions offer significant benefit both to evaluation and to the "spirit of attack." "Fundamental to the concept of combat capability is the desire to match one's own ability against that of his enemy. In peacetime, competition breeds this spirit" (52:37). A two-fold program serves these needs: (1) weapons employment analysis for trends, and (2) results for squadron ranking. So long as the competition is fair and does not become the predominant goal of the overall training program, weapons employment and top gun programs offer a valuable source of motivation and evaluation.

SUMMARY

Despite a number of difficult constraints placed on squadrons, the establishment of a planned approach to continuation training is essential to maximize the benefits of limited resources. To make it all work, the squadron needs to keep these ideas in mind:

1. Get organized early.
2. Set goals and objectives.
3. Interact and coordinate with other agencies and wing.
4. Get wing support early--let them know how their inputs impact the program.
5. Stick with the plan.
6. Evaluate--critically and often.
7. Ensure methods of feedback.
8. Stress the role of the flight commander.

Chapter Five

CONCLUSIONS AND RECOMMENDATIONS

The basic doctrine of the Air Force, expressed in Air Force Manual 1-1 and confirmed during four wars since the birth of airpower, emphasizes that air superiority is the first priority of air forces. The lesson was not easily learned, however. Aviation progress was beset with the traditional problems of the peacetime military: budget cutbacks, arguments over doctrine, inter-service rivalries over control of airpower, intra-service competition over roles and missions, and a lack of foresight into the character of tactical air warfare. Not surprisingly, therefore, the inevitability of air combat renewed the lesson time and again that air superiority is gained to a considerable degree with tactical fighters, in maneuvering combat, and largely based on the quality of our training. Fortunately, time allowed us to overcome the lack of preparation through an extensive national mobilization. In the 1980s and 1990s, though, we may not be afforded the luxury of waiting until war breaks out to prepare for winning it, as the British found out in the Falklands. In a "come-as-you-are" war, day-to-day training may turn out to be the deciding factor.

There is little doubt that the lessons of our last war were not soon forgotten. Today, few would argue against the necessity for tactical air superiority. Despite the budgetary limitations of the 1970s, tactical forces have enjoyed a period of modernization. Flying time has reached the highest levels in a decade. Realistic training, pursued with unprecedented fervor since the war in Southeast Asia, has never been better: Red Flag, the Aggressors, and realistic daily tactics training.

Yet, there is evidence that our air-to-air training may have room for improvement. Accident trends and recurring weak areas during Flag exercises and Aggressor visits point to gaps in training programs. But if the traditional problems with peacetime air combat training are no longer present (budgets, doctrine), then our problems must lie elsewhere. One area worth examination is daily squadron-planned training.

Despite the glamour and publicity of Flag exercises and the Aggressors, these provide only a small percentage of air-to-air training. What is not so apparent is the extent to which other squadron training prepares aircrews for major training exercises. This area deserves some attention. There are indications that squadrons are experiencing some difficulty with planning and executing viable training programs. Squadron supervisors commonly point to a number of hindrances out of their control. The major training publication, TACM 51-50, has grown so long and complex that keeping up with the official requirements becomes the primary emphasis and effort of the training program. An emphasis on events rather than realistic tactical mission scenarios shifts the emphasis to "square-filling" rather than constructing a balanced program to reach meaningful levels of proficiency. The evaluation process, consisting of Stan Eval checkrides, ORIs, and non-flying inspections, is disconnected from the

day-to-day training process. This encourages training artificialities and an emphasis on areas not relating directly to combat capability. Finally, the various policies and procedures to manage flying time encourage a degradation in quality training to meet reporting goals.

Perhaps because of some of these constraints, some squadrons do not consistently plan and execute their own training programs. There are a number of attributes that can enhance the chances of producing an effective training plan. Among these are early planning and coordination, concentration of training into dedicated modules, specific and measurable training objectives, an emphasis on the basics building up to more complex tasks, and frequent squadron-level evaluation of progress. Even with the difficulties facing squadrons, effective training can be planned as an input to rather than a fall-out of the schedule.

To meet the challenges of air combat in the next decade, TAC and every level below must take a careful look at the policies and regulations that impact squadron-level, day-to-day training programs. The following recommendations would significantly improve squadrons' ability to plan and then execute effective training plans:

1. Publish Chapter Four of this report as a text in the Fighter Weapons Instructor Course and as a pamphlet for use by air-to-air squadrons in planning their training programs.

2. Reduce the constraints which limit the ability of squadrons to plan and successfully execute effective air-to-air training programs by adopting the recommendations in Chapter Three. In particular, place emphasis on the following:
   a. Rewrite or replace TACM 51-50.
   b. Strengthen the relationship between training and evaluations.
   c. Increase the flexibility of flying time management.

3. Initiate study of the additional problem areas in Chapter Three through Functional Management Inspections or additional research studies at Air University.

In an era when everything else encourages the kind of effective and realistic training the fighter community has sought for decades, it seems that our only stumbling block is the encumbrance of complex and overly directive training regulations. Implementation of these recommendations would restore considerable autonomy and responsibility to the squadrons, and encourage the tactical innovation essential to meeting the demands of a dynamic threat environment--the key if we are to fight and win in aerial combat.

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GLOSSARY

The following definitions represent a composite from those found in the following publications:

AF Manual 1-1, Basic Aerospace Doctrine of the United States Air Force
Joint Chiefs of Staff Publication 1, Dictionary of Military and Associated Terms
TAC Manual 51-50, Tactical Fighter/Reconnaissance Aircrew Training
TAC Manual 2-1, Tactical Air Operations
TAC Regulation 55-79, Aircrew/Weapons Controller Procedures for Air Operations
TAC Regulation 60-5, Aircraft Flying and Maintenance Plan Scheduling Effectiveness
TAC Supplement 2 to AF Regulation 123-1, The Inspection System

AAC: Alaskan Air Command

AAI: Air-to-Air Interrogator; Air-to-Air Identification

ACBT: Air Combat Training; a general term which includes AHC, BFM, ACM, and ACT

ACM: Air Combat Maneuvers; training designed to achieve proficiency in element formation maneuvering and the coordinated application of BFM to achieve a simulated kill or effectively defend against one or more aircraft from a preplanned starting position; most commonly 2 versus 1

ACMI: Air Combat Maneuvering Instrumentation

ACMR: Air Combat Maneuvering Range

ACT: Air Combat Tactics; training in the application of BFM and ACM skills to achieve a tactical air-to-air objective; most commonly 2 versus 2

ADTAC: Air Defense Tactical Air Command

AFORMS: Air Force Operations Resource Management Systems; a computer system used to track flying training data

Aggressor: A graduate of a formal training course who is schooled in the use of a wide range of enemy tactics and is flying or controlling F-5 aircraft to simulate enemy fighters; created to add realism in air-to-air training

AHC: Advanced Handling Characteristics; training designed to gain proficiency in and to exploit the flight envelope of the aircraft, consistent with operational and safety constraints

Air Defense: All defensive measures, including the use of fighter aircraft, to destroy, nullify, or reduce the effectiveness of attacking enemy aircraft or missiles

Air Superiority: That degree of dominance in the air battle of one force over another that permits the conduct of operations by the former and its related land, sea, and air forces at a given time and place without prohibitive interference by the opposing force; general term encompassing all measures and missions to achieve air superiority

Air-to-Air: General term used to convey combat between aircraft and encompassing such missions as counter air, air defense, sweep, combat air patrol, escort, and force protection

BFM: Basic Fighter Maneuvers; training designed to apply aircraft handling skills to gain proficiency in recognizing and solving range, closure, aspect, angle off, and turning room problems in relation to another aircraft to either attain a position from which weapons may be employed or deny the adversary a position from which weapons may be launched or defeat weapons employed by an adversary; 1 versus 1

BVR: Beyond Visual Range

CAP: Combat Air Patrol (see)

CAS: Close Air Support; air action to support surface operations by attacking hostile targets in close proximity to friendly surface forces

CFT: Composite Force Training; training involving multiple aircraft types and missions designed to provide realistic training in a simulated wartime environment

Chaff: Strips of frequency-cut metal foil, wire, or metallized glass fiber used to reflect electromagnetic energy, usually dropped from aircraft or expelled from shells or rockets as a radar countermeasure

Combat Air Patrol: An aircraft patrol provided over a general or localized area to protect friendly air or ground forces or resources from attack by air

Continuation Training: Training to maintain the proficiency of mission ready aircrews

CPT: Cockpit Procedures Trainer

DACM: Dissimilar Air Combat Maneuvers

DACBT: Dissimilar Air Combat Training; a general term which includes all dissimilar ACBT (DBFM, DACM, DACT)

DACT: Dissimilar Air Combat Training or Dissimilar Air Combat Tactics

Dart: A target towed by a jet aircraft and fired at by fighter aircraft; the mission during which fighters practice air-to-air gunnery against the dart

DBFM: Dissimilar Basic Fighter Maneuvers

DOC: Designed Operational Capability

ECCM: Electronic Counter Countermeasures; actions taken to insure friendly effective use of the electromagnetic spectrum despite the enemy's use of electronic warfare

ECM: Electronic Countermeasures; actions taken to prevent or reduce an enemy's effective use of the electromagnetic spectrum

ECR: Electronic Combat Range

Element: A flight of two aircraft operating as a team and made up of a Flight Leader and a Wingman

Escort: A mission assigning fighters to protect other aircraft from enemy fighters; also called Force Protection

EWWS: Electronic W.rfare Warning Set

FEBA: Forward Edge of the Battle Area; the limit of the area in which ground combat units are deployed

Force Protection: Escort (see)

GCC: Graduated Combat Capability

GCI: Ground Controlled Intercept; the use of ground radar to permit control of aircraft for the purpose of effecting an intercept; also used to refer to the radar facility providing the service

HUD: Heads Up Display; a display of flight, navigation, or attack information superimposed upon a combining glass in the pilot's forward field-of-view

ICS: Internal Countermeasures Set

IFF: Identification Friend or Foe; a system using electromagnetic transmissions to which equipment carried by friendly aircraft respond by emitting pulses to distinguish themselves from enemy aircraft

Intercept: A maneuver that places an aircraft in a position from which a visual identification can be made or weapons fired against a target aircraft

Interdiction: Air operations to delay, disrupt, divert, or destroy an enemy's military potential before it can be brought to bear effectively against friendly forces; usually executed against enemy surface forces, movement networks, lines of communication, and command and control networks

IP: Instructor Pilot

Jamming: The deliberate radiation of electromagnetic energy to impair, obliterate, or obscure the use of electronic equipment or communication systems

LOWAT: Low Altitude Air-to-Air Training; training in the detection, interception, engagement, or evasion of an opposing aerial threat at low altitude

MAJCOM: Major Command; for example, Tactical Air Command (TAC)

MEI: Management Effectiveness Inspection

MiG: The Designation for Soviet aircraft designed by the team of Artem I. Mikoyan and Mikhail I. Gurevich; for example, the MiG-23 Flogger

MQT: Mission Qualification Training; training required to achieve a basic level of competence in the unit's primary tasked missions; its completion is one prerequisite for mission ready status

MR: Mission Ready

MS: Mission Support

ORI: Operational Readiness Inspection

OTU: Operational Training Unit

PACAF: Pacific Air Forces

ROE: Rules of Engagement; directives issued to delineate the circumstances and limitations under which forces may initiate and/or continue combat engagement with other forces encountered; also, peacetime training rules that define the bounds for safe maneuvering and weapons employment intended to allow realistic tactical training to the maximum extent possible

RTB: Return to Base

RTU: Replacement Training Unit

RWR: Radar Warning Receiver

SAM: Surface-to-Air Missile

Scenario: A training mission that simulates a realistic wartime environment, tasking, and threat; based on employment plans and current intelligence

SEAD: Suppression of Enemy Air Defenses; actions taken to neutralize, destroy, or temporarily degrade enemy air defenses in a specific area by physical attack or electronic warfare

Sidewinder: An air-to-air missile using infra-red homing guidance; AIM-9

Squawk: A codeword meaning "activate IFF equipment"

Surge: The production of sorties at rates significantly higher than normal peacetime levels

Sweep: An air-to-air mission to seek out and destroy enemy aircraft in the air in order to gain air superiority

TAC: Tactical Air Command

TAF: Tactical Air Force; the composite of the tactical major commands: TAC, USAFE, PACAF, and AAC

TAFTRAMS: Tactical Air Force Training Management System; a computer system used to track flying training data

TEWS: Tactical Electronic Warfare System; a suite of electronic warfare sets including ICS, RWR, and EWWS

UE: Unit Equipped; the primary aircraft authorized and assigned to a flying unit

USAFE: United States Air Forces in Europe

Ute Rate: Utilization Rate; sorties per aircraft per month

VID: Visual Identification

WSEP: Weapon Systems Evaluation Program

APPENDICES

APPENDIX A. FLYING TIME/SORTIES/PILOTS ANALYSIS

AVERAGE NUMBER OF PILOTS

Average Total Pilots per TAC F-15 Squadron

Operational TAC F-15 squadrons support an average of 38.4 pilots assigned either to the wing or to the squadron. For this study, an average of 39 is used to account for higher headquarters pilots who fly with operational squadrons (Numbered Air Force Stan Eval, IG team, TAC Stan Eval) (26:--; 31:--; 44:--).

Average Pilots per Flying Category

Squadron-assigned:	
Experienced, Squadron Commander & Ops Officer. .	2
Experienced, Instructor pilots	6
Experienced.	6
Inexperienced.	18
Attached, experienced (wing and higher headquarters). .	7
TOTAL	39

TAC MANUAL 51-50 SORTIE REQUIREMENTS

Semi-annual sorties	GCC		Collateral		Total
Inexperienced, C-Level	82	+	14	=	96
Experienced, C-Level	70		13		83
Inexperienced, A-Level	40		10		50
Experienced, A-Level	36		10		46

(40:A1-3)

TACM 51-50 goal: All primary aircrews fly at C-level. MR staff (Squadron Commander, Operations Officer, wing Stan Eval Flight Examiner, wing weapons officer) fly at 80% of C-Level (40:3-2).

UTILIZATION RATE TO FLY TACM 51-50 GOALS

Typical Sqdn Structure	No	Rate	Sorties/half	Total
Sqdn CC, Ops Off	2	80% C	66	132
Instructor Pilots	6	1/day*	111	666
Primary, exp pilots	6	C (exp)	83	498
Primary, inexp pilots	18	C (inexp)	96	1728
Wing MR pilots	2	80% C	66	132
Wing, Headquarters MS	5	A (exp)	46	230
				TOTAL=3386

3386 total sorties per half / 6 months = 564 sorties per month

564 sorties / 24 aircraft = 23.5 ute rate

*Note: Instructor Pilot sorties assume one flight per day, 20 flying days per month, 2 weeks of no flying per half (leave) (63:--; 64:--).

If Instructor Pilots fly at C-level:
83 sorties per half X 6 IPs = 498 sorties instead of 666
Total sorties = 3218 per half = 536 per month = 22.3 ute

UPGRADE REQUIREMENTS

Mission Qualification Training

Assumptions:

2.5 years on station per pilot (70:--)
117 pilots per wing (39 pilots per squadron X 3 squadrons)

Upgrade Requirements = 117 pilots / 2.5 years = 47 pilots per year = 16 per squadron

Upgrade Program (35:2-2)

Mission	No of Acft	X	No of Missions	=	Total
Local Area Orientation	2		1		2
Tactical Intercepts	3		2		6
BFM	2		2		4
ACM	3		2		6
ACT	4		4		16
Mission Ready Check	4		1		4
Extra Rides	3.5 (avg)		2		7

Sorties per MQT upgrade = 49

16 MQT pilots per squadron per year X 49 sorties = 784 sorties/yr

Instructor Pilot Upgrade

Assume 3 IP Upgrades per year

Upgrade Program (35:4-1)

Mission	No of Acft	X	No of Missions	=	Total
Transition	1		1		1
Intercept	1		4		4
BFM	1		2		2
ACM	1		3		3
ACT	1		4		4
Dart	1		2		2
IP Checkride	1		4		4
Extra Rides	3		3 (avg)		9

Sorties per IP upgrade = 29

3 IP upgrades per squadron per year X 29 sorties = 87 sorties/yr

Flight Lead Upgrade

Assume 7 Flight Lead upgrades per year per squadron

Upgrade Program (35:4-2)

Mission	No of Acft	X	No of Missions	=	Total
BFM	2		1		2
ACM	3		1		3
ACT	4		1		4
Dart	2		1		2
Flight Lead certification	4		1		4
Extra Rides	3 (avg)		5		15

Sorties per FL upgrade = 30

7 FL upgrades per squadron per year X 30 sorties = 210 sorties/yr

Total Upgrade Missions

MQT + IP + FL = 784 + 87 + 210 = 1081 upgrade sorties per year
1081 / 12 = 90 upgrade sorties per month

Assuming a 20.0 ute rate: 20 X 24 acft X 6 months = 2880 total sorties per half or 5760 per year

1081 / 5760 = .188 or 18.8% upgrade training

Total Pilots Involved in Upgrade

26 MQT + 3 IP + 7 FL = 26 upgrade pilots per year

Assume 6 weeks per upgrade
26 X 6 = 156 upgrade pilot-weeks
156 / 52 weeks per year = 3 pilots in upgrade at a time (average)
Assume an average of one IP per upgrade pilot
39 total - 3 upgrades - 3 IPs = 33 pilots available for continuation training (average)

Missions during upgrade training that are effective GCC sorties satisfy IP TACM 51-50 GCC requirements and the squadron training goals (Table 16 of this paper).

TRAINING SORTIES AVAILABLE

Overall Collateral Rate

Assuming a 20.0 ute rate: 20 X 24 acft X 6 months = 2880 total sorties per half

GCC + Collateral = Total

Collateral rate = 10% of GCC + 6 per pilot per half (40:A1-1)

(GCC X .1) + (6 sorties per pilot X 39 pilots) = Collateral

GCC + (GCC X .1) + (6 sorties per pilot X 39 pilots) = 2880

GCC = 2405

Collateral = 2880 - 2405 = 475

Collateral Rate = 16.5 % of Total

Sorties Per Pilot

2405 GCC sorties / 39 pilots = 62 GCC sorties per pilot per half
62 / 6 months = 10 per month

475 Collateral / 39 = 12 per half / 6 = 2 per month

2880 Total Sorties / 39 = 74 per half / 6 = 12 sorties per month

GCC Continuation Training Sorties

Assume 20 flying days per month, 20.0 ute rate

90 total upgrade sorties per month
480 total sorties per month
480 - 90 = 390 total continuation training sorties per month

390 X .165 [collateral rate] = 64 collateral continuation training sorties per month

390 - 64 = 326 GCC continuation training sorties per month
326 / 20 = 16 GCC cont tng sorties per day

326 sorties per month x 6 months = 1956 per half
1956 / 26 weeks per half = 75 per week

Time Required to Attain Training Goals

Assume the number of sorties per mission type as in Table 16, Chapter 4, of this paper.

BFM + AHC: 6 sorties X 33 pilots = 198 sorties
198 / 16 sorties per day = 12+ days
198 / 75 sorties per week = 2+ weeks

ACM: 5 sorties X 33 = 165
165 / 16 = 10+ days 165 / 75 = 2+ weeks

ACT: 15 sorties X 33 = 495
495 / 16 = 30+ days 495 / 75 = 6+ weeks

DACT: 19 sorties X 33 = 627
627 / 16 = 39+ days 627 / 75 = 8+ weeks

Day intercepts, dart, night intercepts: 10 sorties X 33 = 330
330 / 16 = 20+ days 330 / 75 = 4+ weeks

Deployments and exercises: Number of weeks based on tasking.

Note: ORI and sortie surge flying consist of a variety of GCC missions satisfying some of the requirements above.

APPENDIX B. ADVANCED HANDLING EXERCISES

1. Acceleration maneuver

   a. 20,000 feet MSL
   b. 8 units AOA
   c. Accelerate from 300 knots to 1.1 Mach
   d. Note time and altitude lost
   e. Repeat as desired with various G-loads and bank angles: compare time and altitude lost

2. Minimum-time high-speed reversal

   a. 18,000 feet MSL
   b. Mach 1.1
   c. Reverse direction by 180 degrees
   d. Accelerate to 1.1 Mach at 18,000 feet MSL
   e. Note time
   f. Refer to Fighter Weapons Texts for technique

3. High AOA maneuvering

   a. 20,000 feet MSL
   b. 30 units AOA
   c. Establish left turn in mil power and reverse to right turn
   d. Establish right turn in AB and reverse to left turn
   e. Compare reversals with and without rudder

4. Energy maneuvering

   a. 15,000 feet MSL
   b. 425 KCAS
   c. Establish level turn
   d. Increase G and power to sustain 425 knots
   e. Note max level-flight, airspeed-sustained G
   f. Select full AB, maintain sustained G and 425 KCAS
   g. Note pitch angle and altitude change after 180 degrees of turn
   h. Repeat maneuvers varying starting altitude

APPENDIX C. BASIC FIGHTER MANEUVERS (BFM) SCENARIOS

BFM-1: OFFENSIVE BFM

1. Objectives: Starting from a position of advantage (perch):
   a. Obtain a valid kill
   b. Stay offensive
   c. Separate prior to losing an offensive advantage

2. General parameters:
   a. Power: Full AB for both players
   b. Ordnance: AIM-7 / AIM-9 (P, L, or M as loaded) / Gun
   c. Starting altitude: 20,000 feet MSL
   d. Starting aspect angle: 40 degrees
   e. Kill: Any 2 shots meeting kill parameters or one guns track (or squadron standard kill criteria)

3. Sequence of events:
   a. G-awareness or warm-up exercise
   b. Cine track exercise
   c. 3000' perch / attacker: 350 KCAS / defender: 320 KCAS
   d. 6000' perch / attacker: 420 KCAS / defender: 400 KCAS
   e. 9000' perch / airspeeds same as 6000'
   f. Gun or missile exercises during area exit

4. Knock-it-offs:
   a. TACR 55-79 Rules of Engagement
   b. Valid Kill
   c. Valid Separation

5. Alternate mission: Advanced Handling Characteristics

BFM-2: DEFENSIVE BFM

1. Objectives: Starting from a position of disadvantage (perch):
   a. Deny attacker a valid shot
   b. Get to neutral
   c. Separate or go offensive

2. General Parameters: same as BFM-1

3. Sequence of events:
   a. G-awareness or warm-up exercise
   b. Cine track exercise
   c. 9000' perch / attacker: 420 KCAS / defender: 400 KCAS
   d. 6000' perch / airspeeds same as 9000'
   e. 3000' perch / attacker: 350 KCAS / defender: 320 KCAS
   f. Gun or missile exercises during area exit

4. Knock-it-offs: same as BFM-1

5. Alternate mission: Advanced Handling Characteristics

BFM-3: NEUTRAL BFM

1. Objectives: Starting from a neutral position:
   a. Go offensive
   b. Stay neutral
   c. Separate prior to going defensive

2. General Parameters:

   a. Power: Full AB for both players
   b. Ordnance: AIM-7 / AIM-9 (P, L, or M as loaded) / Gun
   c. Starting altitude: 20,000 feet MSL
   d. Kill: Any 2 shots meeting kill parameters or one guns track (or squadron standard kill criteria)

3. Set-ups:
   a. Visual Butterfly #1
      (1) 400 - 450 KCAS
      (2) Cleared to maneuver at visual turn-in
   b. Visual Butterfly #2
      (1) 400 - 450 KCAS
      (2) Left-to-left level pass
      (3) Cleared to maneuver at merge
   c. Visual Line-Abreast #1
      (1) 300 KCAS
      (2) 3000' line abreast
      (3) Maneuver after "fight's on" call when both players are ready
   d. Visual Line Abreast #2
      (1) 420 KCAS
      (2) 6000' line abreast
      (3) Maneuver after "fight's on" call when both players are ready

4. Sequence of events:
   a. G-awareness or warm-up exercise
   b. Cine track exercise
   c. Neutral set-ups in desired order
   d. Gun or missile exercises during area exit

5. Knock-it-offs: same as BFM-1

6. Alternate mission: Advanced Handling Characteristics

APPENDIX D. AIR COMBAT MANEUVERS (ACM) SCENARIOS

1. Element Objectives:

a. Starting from a tally-ho on a bandit in the front or side quadrant, obtain a kill or separate prior to absorbing a shot.

b. Starting from a tally-ho on a bandit at 6 o'clock, deny the attacker a valid shot, separate, or go offensive.

c. Starting BVR, obtain a tally-ho prior to a valid shot by the single, defeat the attack, separate, or go offensive.

2. Objectives for the single:

a. Defensive: Deny the element a valid kill and separate.

b. Offensive: Obtain at least one valid shot then separate.

c. BVR: Attack the element considering all environmental factors (sun, cloud cover background, etc.), geometry, GCI and onboard radar to achieve an offensive advantage; obtain a valid shot; separate before becoming defensive.

3. General parameters:

a. Power: Full AB for all players

b. Ordnance: AIM-7 / AIM-9 (P, L, or M as loaded) / Gun

c. Starting altitude: 18-20,000 feet MSL

d. Kill: Any 2 shots meeting kill parameters or one guns track (or squadron standard kill criteria)

e. UHF: Separate frequencies with common aux if available

f. Kill removal for element: Aileron roll, exit engagement, maintain visual

4. Sequence of events:

a. G-awareness or warm-up exercise

b. ACM set-ups as desired

c. Gun or missile exercises during area exit

5. Set-ups:

a. ACM-1 (Front Quarter Visual)

(1) 400-450 KCAS

(2) All 3 aircraft line-abreast

(3) Single cleared to turn 45 degrees away

(4) At 5 NM or limits of visual range, element executes a delayed 90 into the single

(5) Single cleared to maneuver at delayed 90 call (see Figure 1)

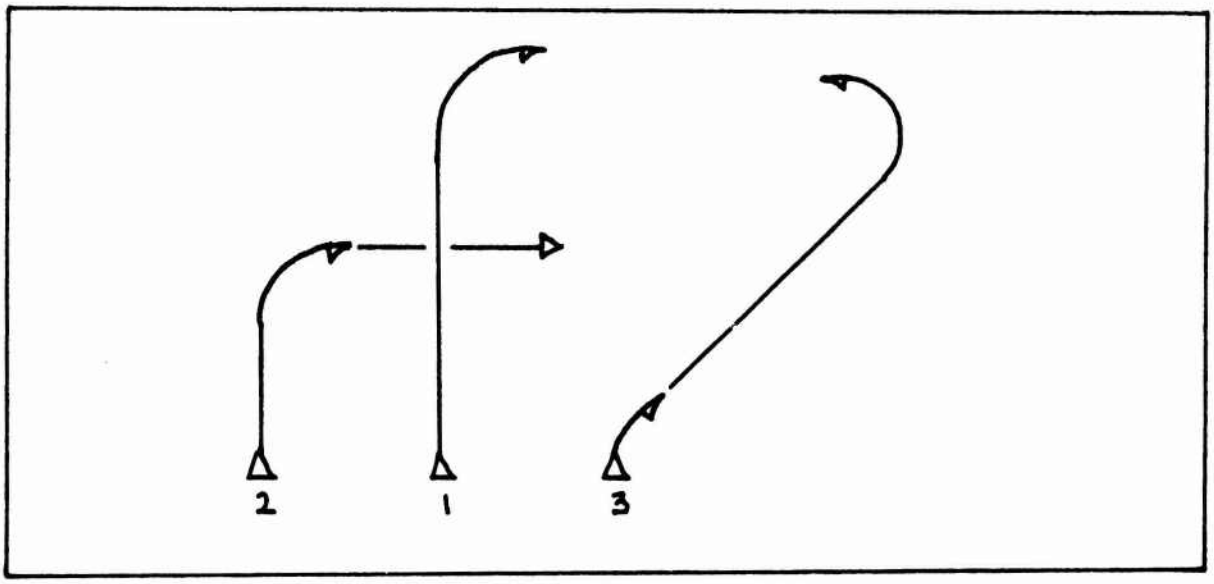

Figure 1. FRONT QUARTER ACM SET-UP

b. ACM-2 (Rear Quarter Visual / Initial Moves)
(1) 400-450 KCAS
(2) Element in tactical formation
(3) Single 2 NM trail
(4) Single maneuvers to AIM-9P parameters
(5) Element cleared to maneuver at single's initial shot call (this shot does not count for kill removal)

c. ACM-3 (Beyond Visual Range / Point Defense / Visual CAP)
(1) Element CAPs area center point in appropriate formation and airspeed
(2) Single cleared off BVR
(3) GCI: full for single, none for element
(4) Element calls "ready"--single cleared to attack
(5) All players cleared to maneuver after element calls ready
(6) Element blocked as desired

6. Knock-it-offs:
a. TACR 55-79 Rules of Engagement
b. Single is killed
c. Both aircraft in element killed
d. Valid separation by single or element

7. Alternate Missions:
a. 2-ship: BFM-1, 2, or 3
b. Single-ship: Advanced Handling Characteristics

MONTH OCTOBER YEAR 1985

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
29	30 BACK TO BASICS PHASE Advanced Handling (AHC)	1	2	3	4 BFM Academics	5
6	7 BFM	8	9	10	11 AIM-9 Academics	12
13	14 (HOLIDAY)	15 BFM	16	17	18 ACM Academics	19
20	21 ACM	22	23	24	25 Radar Academics	26
27	28 ACM	29	30	31	1 ECCM Academics	2
3	4 ECCM PHASE: 2 V X ACT & DACT AREA DEFENSE	5 SCENARIO WITH	6 ECM	7	8 TEWS Academics	9

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Figure 2